AD A079948

DDC FILE COPY

NAMRL-1259

LEVEL

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: BASIC SQUADRON VT-10

W. Carroll Hixson, Fred E. Guedry, Jr., Garry L. Holtzman, J. Michael Lentz, and Patrick F. O'Connell

8 Apr 79

72

F51524

ZF51524005

Interim Rept.

Best Available Copy

April 1979

406 061 80 1 28 014

Approved for public release; distribution unlimited.

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: BASIC SQUADRON VT-10

W. Carroll Hixson, Fred E. Guedry, Jr.,

Garry L. Holtzman, J. Michael Lentz, and Patrick F. O'Connell

Naval Medical Research and Development Command
ZF51.524.005-7032

Approved by

Ashton Graybiel, M.D.
Assistant for Scientific Programs

Released by

Captain R. E. Mitchell, MC, USN
Commanding Officer

8 April 1979

NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY
NAVAL AIR STATION
PENSACOLA, FLORIDA 32508

SUMMARY PAGE

THE PROBLEM

Airsickness in Naval Flight Officer (nonpilot) training squadrons can be considered to be a significant biomedical risk having both direct and indirect influence on the cost of training aircrew personnel. Motion sickness in students during flight can degrade performance of assigned flight tasks, often resulting in the need for the hop to be reflown so as to accomplish a required degree of proficiency. Dollar costs also result when students attrite because of airsickness, with these costs rising rapidly when the attritions occur late in the training program or in the fleet proper. Currently, there are no operational data available to describe either the actual incidence or resulting costs of the airsickness risk in these squadrons, and hence, there is insufficient information available for flight surgeons and medical boards to make decisions concerning disposition of airsick individuals. In addition, validated biomedical tests of motion sickness susceptibility to screen and select aircrew candidates best suited for fleet assignments involving different degrees of motion stress are not yet available.

FINDINGS

A longitudinal study has been initiated of airsickness problems in the basic, advanced, and type-specific fleet readiness (RAG) squadrons comprising the complete Naval Flight Officer Training Program. Flight performance data, based upon both instructor and student judgments of airsickness severity, are being collected in each squadron on an individual-student basis. In addition, a large segment of the study population has been exposed to a prototype series of laboratory tests of motion sensitivity which will be related to the subsequent flight data. In addition to identifying the incidence and severity of airsickness in the individual squadrons, these flight data will have the potential to serve as operations-based validation criteria for establishing the relative merit of the different components of the laboratory test battery.

This report deals with the airsickness problem in Basic Training Squadron VT-10 where all Naval Flight Officers begin their flight training. The data from 5,394 hops flown by 408 students indicate that airsickness occurred on approximately 16 percent of the total hops flown, vomiting occurred on 7 percent of the total, and performance degradation caused by airsickness resulted on 11 percent of the flights. Approximately 74 percent of the students reported being airsick on at least one flight, 39 percent reported vomiting on one or more flights, and 59 percent considered their flight performance to have been degraded by airsickness on one or more hops. The report details the incidence of airsickness by hops and by students, presents the results of several brief motion reactivity tests to which a large segment of the population was exposed, and relates the flight and test data for different student subpopulations.

ACKNOWLEDGMENTS

The project investigators wish to thank Mr. Joel W. Norman, Perceptual and Behavioral Sciences Division, and Mr. A. N. Dennis, Jr., Bioenvironmental Engineering Division, for their sustained contributions to the data acquisition and verification phases of the study. Correspondingly, the investigators wish to thank Mrs. Jack A. Martin, Perceptual and Behavioral Sciences Division, for her many and varied contributions to the study including the preparation of this manuscript. Appreciation is extended also to Dr. John O. deLorge, Biomedical Sciences Division, for the many hours he spent with the first author discussing alternative short- and long-term statistical approaches and methods for analyzing the project data. Acknowledgment is made also to Captain Steve Mugg, USMC, VT-10; Lieutenant Commander Ron Ayer, USN, VT-10; Lieutenant Commander D. K. Kirk, USN, U. S. Naval Aviation Schools Command; and Commander A. W. Marcantonio, USN, CNET, for their cooperation. In addition, especial appreciation is extended to the many hundreds of students and their instructors who conscientiously provided the airsickness data throughout the course of flight training in VT-10.

- - - - - - - - - -

Patrick F. O'Connell, CAPT, MC, USN, and Garry L. Holtzman, CDR, MC, USN, are with the Naval Aerospace Medical Institute, Pensacola, Florida.

INTRODUCTION

This is the first in a series of research reports dealing with a longitudinal study of airsickness in Naval Flight Officer (NFO) students being trained for a variety of different nonaviator flight assignments in fleet squadrons. The study is designed to investigate the incidence and severity of the airsickness experienced by a sample of the NFO population on an individual-student basis as they sequentially progress through the basic, advanced, and fleet readiness (commonly referred to as RAG) squadrons comprising the NFO training syllabus. This specific report details the findings for Basic Training Squadron VT-10 in which all NFO students receive their initial flight training.

As a matter of background, the project originated as a result of numerous airsickness problems and questions that were directed to this activity by training command personnel responsible for delivering qualified NFOs to the fleet, by flight surgeons responsible for the medical management of naval aviation aircrew, and by career naval aviators and flight officers experiencing chronic airsickness difficulties during performance of their fleet flight duties. Training command personnel raised questions concerning the over-all cost of the airsickness risk to the NFO training program. Specific problems included degraded flight performance of airsick students, the need to repeat hops when performance was inadequate, loss of personnel and training time due to airsickness-related attrition, the potential nonoptimal usage of airsickness medication over an extended period of the training program, and the occasional graduation of airsick-susceptible NFO students who were able to complete the training program but could not perform adequately in the fleet. Concern was also expressed about the need for some form of laboratory test battery to medically screen airsickness susceptibles early in the training program to reduce the costs of mid- or late-term attrition.

Similar questions were raised by flight surgeons who were dealing with airsick flight personnel. They were interested in more specific knowledge of a) the profile of airsickness during NFO training and on into the fleet, b) the basic causes of airsickness, c) the probability of eventual adaptation to flight given a particular history of motion sickness, d) the use of medication, especially with provocative hops, to assist in the adjustment period, and e) the probability of recurrence of motion sickness with new fleet assignments. They also were interested in the availability of preflight laboratory tests that might identify individuals in need of early treatment and/or alternative naval service, and in additional laboratory tests that would aid in a comprehensive evaluation of specific airsick cases. In addition, this activity was often contacted directly by fleet aircrew personnel suffering repeated airsickness difficulties who raised questions similar to those of the flight surgeons.

These questions are most justifiable since in military air training, a high percentage of students (60-80 percent) suffer some degree of motion sickness at one time or another (7,8). Benson (personal communication with F. E. Guedry, 1975, advance copy of motion sickness chapter written for RAF Textbook of Aviation Medicine) has reported that almost all student navigators are affected to some degree in high performance aircraft, and about 50 percent vomit at some time during training. Incidence of sickness in student pilots is lower than in nonpilot flight officers, but between 10 and 30 percent are clearly motion sick at some time (4,5,7,9,11). Armacost (personal communication with F. E. Guedry, 1975, questionnaire results on 99 Navy pilots and NFOs), in a recent survey, found that 77 percent observed some sign of airsickness in themselves after completing basic training. He also indicated that 26 percent of the NFOs indicated that they regarded motion sickness as a significant problem in naval aviation, and 79 percent of these experienced motion sickness the first year after assignment to a fleet squadron. Estimates of the number of students attriting during flight training because of airsickness range between 1 and 7 percent (7), with some of the variation in figures being due to differences in such factors as supply and demand for flight students, criteria used in motion sickness classification, and differences in methods of determining and classifying reasons for attrition.

The practical significance of motion sickness clearly depends upon the job of the individual. Passengers without an important task during a flight may be only inconvenienced and uncomfortable. On the other hand, performance of individuals with definite mental or physical tasks to carry out in the motion environment is not only disrupted by emesis, but also may be prevented by prostration. The cost of these obvious effects of motion sickness may be less than the cost of more subtle side effects such as drowsiness, lethargy, and mental depression which could retard progress in training by degrading alertness and morale in the performance of routine duties (2), and also could reduce motivation to remain in the aviation training program. It is well known that some individuals recover very slowly from an airsickness episode, so that academic preparation for the next hop will be diminished. Potential airsickness-related costs to the Navy, therefore, accrue from increased time to train (including repeated hops), attrition, and psychological and medical evaluation of airsick cases. From the point of view of the individual, a potentially valuable person might suffer a failure, with an attached stigma that could influence his value to the Navy and his personal life.

It is commonly believed that the problem of airsickness eventually diminishes in aviation because of man's adaptive abilities. There is no question that satisfactory adaptation occurs in many individuals who at first suffer some degree of airsickness. Some published data give the impression that airsickness after the initial ten or twelve hops is almost negligible because adaptation solves the problem. However, the costs accrue during the inflight adaptation process and also from the 1-7 percent airsick attritions. Moreover, there is reason to doubt that adaptation by itself reduces the problem down to this level, especially in Naval Flight Officer students. Most airsickness incidence studies heretofore have not clearly addressed the possibility that lowered incidence as training progresses is partially due to airsickness attritions. Conversely, many attrition studies have not clearly taken into account the fact that lowered motivation, morale, and even mental depression are known "side-effects" of motion sickness.

Current and projected Navy Research, Development, Test, and Evaluation requirements which document the need for research on these airsickness problems derive from several sources. On a broad basis, the POM-80 Department of the Navy Planning and Program Guidance Memorandum (3) stresses the need for programs which can increase training efficiency, reduce attrition, and validate the effectiveness of Navy training programs. In turn, the Navy Decision Coordination Paper: Fleet Health Standards (6) emphasizes the critical requirement for health and performance validated standards of personal fitness during this period of limited manpower availability. This document also recognizes that special standards of fitness must be developed for particular naval occupations or duty assignments, with medical screening standards for service entry, assignment, and retention serving as one of the principal development and validation objectives.

The Science and Technology Objective Personnel/Medical (STO-PN) document (1) provides direct and specific requirements for this project. The Biomedical Support: Occupational Safety and Health (STO-PN, 11-D-1, Critical Priority) problem statement emphasizes the fact that environmental stresses such as motion pose a threat to the health and performance of personnel. The related Physical and Mental Fitness statement (STO-PN, 11-D-2, High Priority) notes that fleet tasks may be degraded if the stress tolerance level of individuals is such that performance is impaired and states the requirement for technologies to diagnose stress and screen susceptibles. In the Fitness Standards and Screening (STO-PN, 11-D-6, High Priority) statement it is recognized that the "cost and effectiveness of both training and fleet operations are, for the most part, dependent on the quality of the biomedical screening of applicants." The problem statement calls for technologies and specialized testing devices that accurately assess the sensory, mental, and physiological properties required for effective performance in the fleet.

In the Personnel: Reduction in Attrition (STO-PN, 11-A-13, Critical Priority) problem statement a requirement is established for comprehensive information on the reasons why personnel are lost from the Navy for all causes. In the related Utilization and Productivity section (STO-PN, 11-A-9, Priority) it is stated that the Navy cannot afford to utilize military personnel below their maximum productive capability. In like manner, the Human-Factors Engineering: Motion Effects on Personnel (STO-PN, 11-C-1, Priority) problem statement notes that motion problems continue to reduce the effectiveness of personnel. Requirements for the basic incidence and cost data to be generated by the project derive also from the Training: Measuring the Cost and Effectiveness of Training (STO-PN, 11-B-12, High Priority) problem statement and the related Training Practices section (STO-PN, 11-B-1, Critical Priority).

To address these requirements a biomedical research program was designed to study the incidence and severity of the airsickness problem during NFO training, using both student and instructor judgments of concomitant flight performance. The program differs significantly from previous airsickness studies in several respects. First, the investigation is based upon the longitudinal follow-up of individuals throughout the entire training program instead of just within one specific squadron. Secondly, through the cooperation of Naval Aviation Schools Command, approximately half of the NFO study population was exposed to short tests of motion reactivity prior to their beginning flight training. Although not all elements of the test battery currently in use are aimed specifically at airsickness, the test results, singly and in combination, are expected to give some insight into the optimal route for identification of the airsickness sensitivity of individual students. The flight data, in addition to identifying the magnitude of the airsickness problem in each NFO squadron, will also provide a direct measure of the effectiveness of the laboratory tests. This latter factor is most significant in that there is not a single preceding study in aviation medicine that provides detailed longitudinal inflight criterion data for validating the potential merit of preflight motion sickness susceptibility tests.

PROCEDURE

Figure 1 is a block diagram of the different pipelines followed by NFO students before assignment to the operational fleet squadrons. Basic flight training begins in Squadron VT-10 and then progresses through advanced training to the type-specific fleet readiness (RAG) squadrons. The student population is subdivided into two distinct groups: One group is selected for assignment to the Mather Air Force Base (MAFB) Advanced Training Squadron. This group flies only five familiarization hops (FM1 through FM5 - - see Appendix A) in Squadron VT-10 before being assigned to MAFB for navigator training, after which most are assigned to P-3 aircraft. The second group of students flies the same five familiarization hops plus thirteen additional hops, as described in Appendix A. The assignment of this latter group to a specific advanced training squadron does not occur until completion of their flight training in Squadron VT-10. This group then follows one of three different advanced training pipelines identified as VT-86-AJN, VT-86-RIO, and ATDS in Figure 1. The VT-86-AJN population is trained for fleet assignments involving a variety of attack and antisubmarine warfare (ASW) aircraft including the S-3, A-6, and EA-6. The VT-86-RIO population is trained for fleet operations involving radar intercept duties in F-4 and F-14 fighter aircraft. A small number of students receive the ATDS assignment and are trained to perform flight officer duties in E-2 aircraft. All advanced training students receive additional type-specific training in RAG squadrons before being assigned to an operational fleet squadron.

The longitudinal aspects of the study are directed at following a relatively large number of NFO students throughout the basic, advanced, and RAG squadron phases of their training. This specific report is concerned with the airsickness problem during basic training in Squadron VT-10. Data pertaining to the total number of VT-10 students included in the study and the number of students assigned to each of the four different advanced training squadrons following graduation from VT-10 are listed next to the appropriate blocks in Figure 1. The number of students who attrited from Squadron VT-10 after they began flight training is also shown.

The two-sided questionnaire developed to evaluate the airsickness problem in Squadron VT-10 is shown in Figure 2, with the form filled out by the student at the top and the form filled out by the instructor at the bottom. The study protocol was such that one questionnaire was completed for each separate hop flown. To minimize problems with confidentiality of questionnaire data, the student and instructor sections were printed on opposite sides of the form, with a fold line and self-adhesive tab provided to allow the student to seal his responses from direct view. The student wrote his name at the top of the instructor form which was then completed by the instructor and deposited into a sealed collection box.

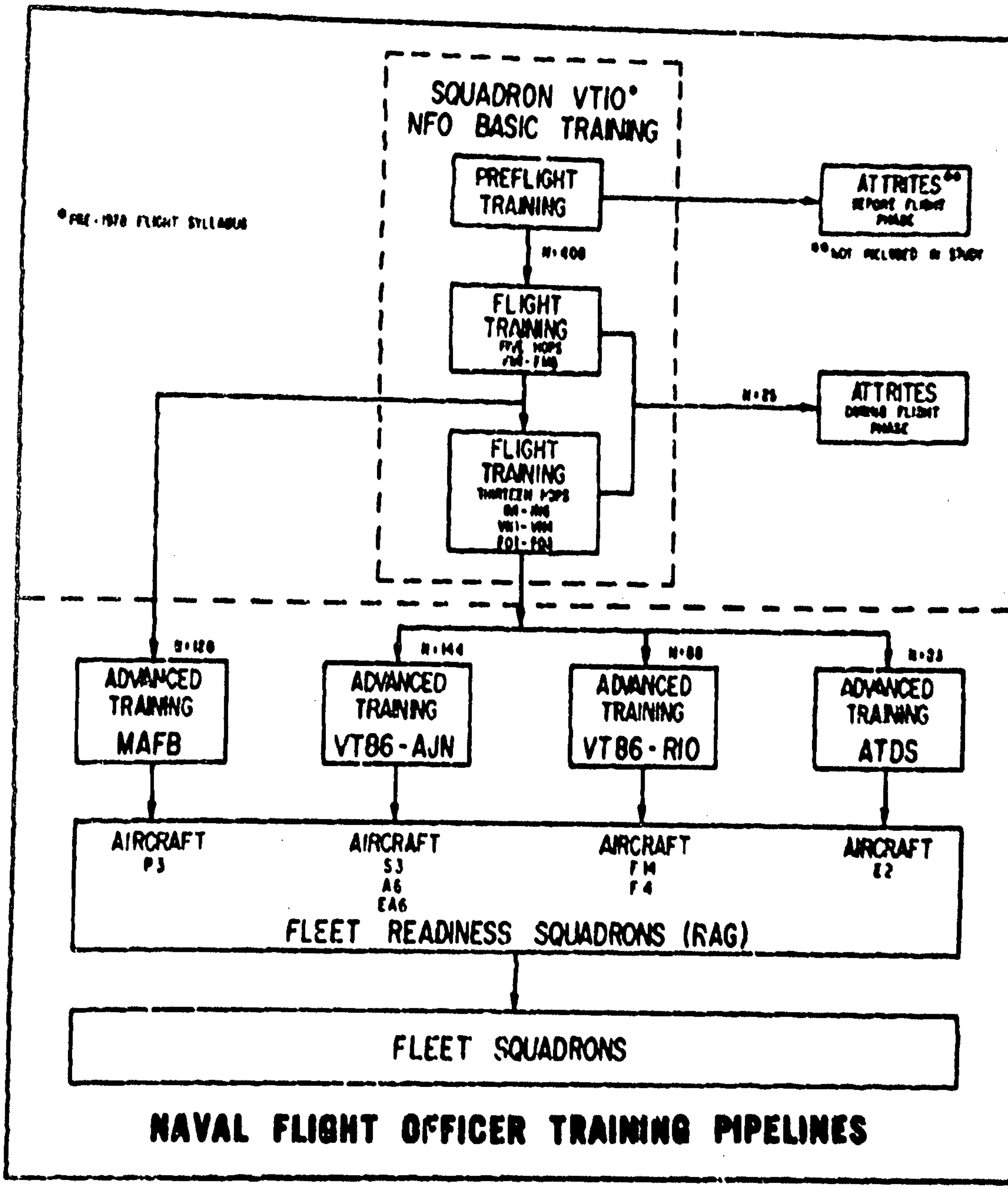


Figure 1

Block diagram showing training pipelines followed by Naval Flight Officer students beginning with basic training in Squadron VT-10 and following through various advanced and fleet readiness (RAF) squadrons before receiving fleet assignments.

STUDENT FORM	NAMI / NAMRL AIRSICKNESS RESEARCH PROJECT				STUDENT FORM
Student SSN	Squadron No.	Hop No.	Julian Date	1/8 Time (local)	
PLEASE ESTIMATE THE FOLLOWING BY MARKING THE APPROPRIATE ANSWER: REPLY TO EACH QUESTION					
AIRSICKNESS (Feeling motion sick whether you vomited or not)	NONE	MILD	MODERATE	SEVERE	36
VOMITING	NONE	ONCE	TWICE	THREE OR MORE TIMES	37
PERFORMANCE DEGRADATION (Due to airsickness)	NONE OR N/A	MILD	MODERATE	SEVERE	38
NERVOUSNESS (Experienced before/during this flight)	NONE	MILD	MODERATE	SEVERE	39
Did you take any medication for airsickness for this flight?	NO	YES			30
T-28 FLIGHTS SHOULD ALSO COMPLETE THE FOLLOWING					
List hops in order flown for this flight					
Check the box under YOUR hop.					47
If airsick, when did it occur relative to YOUR hop? (Mark more than one box if appropriate)	NOT AIRSICK 48	BEFORE 49	DURING 50	AFTER 51	

FOLD ALONG THIS LINE

INSTRUCTOR FORM	NAMI / NAMRL AIRSICKNESS RESEARCH PROJECT				INSTRUCTOR FORM
NAME OF STUDENT (Last name first, Initials)					
PLEASE ESTIMATE THE FOLLOWING BY MARKING THE APPROPRIATE ANSWER: REPLY TO EACH QUESTION					
AIRSICKNESS *** (Student appeared motion sick whether he vomited or not)	NONE	MILD	MODERATE	SEVERE	53
VOMITING	NONE	ONCE	TWICE	THREE OR MORE TIMES	54
PERFORMANCE DEGRADATION (Due to Airsickness)	NONE OR N/A	MILD	MODERATE	SEVERE	55
APPARENT NERVOUSNESS (Before and/or during the flight)	NONE	MILD	MODERATE	SEVERE	56
ROUGHNESS OF FLIGHT (Turbulence or pilot technique)	NONE	MILD	MODERATE	SEVERE	57
If this hop incomplete, was airsickness a factor? (Mark more than one box if appropriate)	NONE OR N/A 58	YES This Student Airsick 59	YES Another Student Airsick 60	YES Instructor Airsick 61	
Please record flight grades Example [0][3] for 3	U	BA	A	AA	
INSTRUCTOR COMMENTS					70

***NOTE TO INSTRUCTOR: Research has shown that some people can feel very sick without vomiting. As a reminder, some of the signs of airsickness are pallor, sweating, heavy breathing, facial expressions, excessive swallowing, drowsiness, and verbal complaints. However, USE YOUR OWN JUDGEMENT.

Figure 2

Student (top) and Instructor (bottom) airsickness questionnaire utilized to collect the Squadron VT-10 data. For the actual questionnaire the student form was printed on one side of the sheet and the instructor form on the opposite side with a self-adhesive tab provided to allow the student to seal the folded questionnaire before the instructor entered his ratings.

Basic identification data provided at the top of the student form included the student's social security number, squadron name (VT-10 in this case), abbreviated name of the hop (see Appendix A), Julian date of the flight, and local takeoff time. Immediately below, four forced-choice ratings were presented to evaluate the relative magnitude of airsickness experienced during the flight, the number of times vomiting occurred, the relative magnitude of any flight performance degradation that may have occurred as a result of airsickness, and the relative magnitude of any nervousness experienced before or during the flight. A fifth item requested a yes or no answer relative to the use of airsickness medication on the hop. A second set of questions was asked of those students who flew their hops in the multiseated T-39 aircraft (instead of the two-seated T-2 aircraft most often used). Since the T-39 aircraft allowed two or more students to be sequentially trained on different syllabus hops during the same flight, these questions sought background information on the time airsickness may have occurred relative to the time the student performed his assigned hop tasks.

The instructor form also provided forced-choice ratings for the same airsickness, vomiting, performance degradation, and nervousness measures included on the student form; the reason for this apparent redundancy was to establish the degree to which the instructors were aware of the students' experience. In addition, the instructor was asked to rate the roughness of flight in terms of turbulence or pilot technique. A sixth question was directed at determining the number of hops that had to be terminated before completion of training as a result of airsickness. Space was also provided for the instructor to enter the flight grades issued to the student for the given hop. Each hop within the syllabus is based upon the completion of a specific number of tasks, with one grade (unsatisfactory, below average, average, and above average) issued for each assigned task. Since the number of tasks comprising a given hop training exercise varies from hop to hop, the total number of grades issued varies from hop to hop. Both the student and instructor forms included space for written comments on their experiences.

To initiate the study, project investigators gave each newly entering class of NFO students thorough briefings on the purpose of the research and the methods to be followed in completing the questionnaire. It was emphasized to the students that the project was of a research nature and that their questionnaire responses would be held in confidence and in no way affect their own progress in training. Blank questionnaires and collection boxes were then placed in the squadron debriefing rooms. Completed questionnaires were key-punched on a single card following the card-column code identified next to each questionnaire item listed in Figure 2. To ensure the identification of those response items for which either the instructor or student failed to respond, the key punch operators entered a zero. The none, mild, moderate, and severe ratings associated with a given response item were then coded with a 1, 2, 3, and 4 rating score, respectively.

At the same time a large number of these students was exposed to a variety of laboratory tests undergoing evaluation as potential measures of airsickness susceptibility. Brief descriptions of these tests are provided in Appendix B, with related references that provide more detailed information on test techniques and procedures. The results of those tests were also key-punched on cards.

The resulting card data were then entered and disk-stored in a digital computer (Hewlett-Packard 5451B). To allow the project investigators to monitor and interact with the questionnaire data on a direct day-to-day basis, software was developed to verify, list, group, and edit the questionnaire data on an individual-subject basis. This software was designed around two master disk files. One contained all of the basic student identification data including the VT-10 class number, date of graduation from VT-10, the advanced squadron assignment received, and the results of the laboratory airsickness susceptibility tests. The second master file involved a separate record for each of the questionnaires received from the student. These questionnaires were entered sequentially as received from the squadron.

When all of the students included in the VT-10 population either graduated or attrited, a second master set of disk files was then structured to facilitate more thorough analysis. One file contained all of the student identification data described previously, with the condition that only those students for which at least one questionnaire had been received were included in the new student listing. The original questionnaire data were relocated sequentially on an individual-student basis in a second disk file. The locations of the beginning and end questionnaire disk records in this file were then stored for each student in the master subject identification file. This approach was selected to speed up the analysis of the questionnaire results on an individual-subject basis. At this time unweighted and weighted summary questionnaire indices, to be detailed in a later section, were calculated for each student and stored in the master student identification file.

RESULTS AND DISCUSSION

Before detailing the statistical results of the questionnaire data, a few cursory comments will be made relative to the basic data collection aspects of the study. In general, excellent cooperation was obtained from the student and instructor groups participating in the study. A total of 5,394 validated questionnaires involving a total of 408 VT-10 students were collected during this phase of the longitudinal study. In a small number of cases students did not complete a questionnaire immediately after flying a given hop. In those cases it was general practice to contact the student and request that a postdated questionnaire be submitted for the missing hop. On a student questionnaire (see Figure 2 - top) extensive data were received on all items except the block that related to the time airsickness occurred on the T-39 aircraft. This aircraft, larger than the two-seated T-2 aircraft used to fly the majority of the hops, permitted two or more students to be successively trained on different hops scheduled for a single T-39 flight. Since a relatively low number of questionnaires (less than 11 percent of the total) were received on the T-39 flights, these data are not addressed in this report. Extensive data were also obtained from the instructor questionnaire (see Figure 2 - bottom). In the case of the line item dealing with the incidence and cause of aborted or incomplete hops, the instructors indicated that only seven of the 5,394 hops flown were aborted during the course of the study.

The data base of 408 students was derived primarily from fifteen successive VT-10 classes, beginning with Class 7625 and ending with Class 7707. In addition, there were a few students from earlier classes who had their flight training delayed for various reasons not pertinent to the study. As indicated by the numerical data entered adjacent to the flow line in the Figure 1 block diagram of the NFO training pipeline, 25 (6.1 percent) of the 408 VT-10 students attrited from the program after beginning flight training. Since the project objectives center on quantifying the airsickness performance of the student population on an individual basis, students who attrited from VT-10 before beginning flight training were not included in the study population. In essence, only those students for which at least one airsickness questionnaire was received were incorporated into the data base. As pointed out by various training management personnel, this 6.1 percent attrition rate was exceedingly low as compared to previous equivalent sequences of classes. Of the 408 total students, 383 (93.9 percent) graduated, with 128 (31.4 percent) receiving advanced training assignments to MAFB, 144 (35.3 percent) to VT-86-AJN, 88 (21.6 percent) to VT-86-RIO, and 23 (5.6 percent) to ATDS.

To facilitate the over-all interpretation of the VT-10 airsickness questionnaire data, the study results are reported and discussed under six different subheadings. In the first section the questionnaire data are used to define the incidence and severity of airsickness on each of the 18 hops comprising the entire VT-10 flight syllabus. In the second section the same questionnaire data are discussed in relation to the contribution of students experiencing airsickness on a repeated basis to the over-all airsickness incidence figures. In the third section unweighted and weighted airsickness indices are developed to quantitatively define airsickness incidence and severity on an individual NFO student basis. The fourth section utilizes these indices to discuss similarities and differences among different subpopulations defined by the graduated or attrited students. The fifth section utilizes these same indices in various combinations to both define and compare the performance of nonsusceptible student groups with highly susceptible student groups within the over-all population. The last section presents a rank correlation matrix analysis of the relationships found to exist between and across the different flight indices and laboratory test scores.

AIRSICKNESS INCIDENCE AND SEVERITY: INDIVIDUAL HOP ANALYSIS

The principal elements of the data derived from the airsickness questionnaires are tabulated in Table I for each of the 18 hops comprising the VT-10 flight syllabus. The table contains separate listings for the student and instructor ratings of the incidence and magnitude of the four principal response measures of the study; i.e., airsickness, vomiting, inflight performance degradation caused by airsickness, and nervousness. For each of these measures four percentage values corresponding to classifications present, mild, moderate, severe are presented for each of the 18 hops. Each datum below a given (see Appendix A) hop name represents the percentage of the total number of hops flown of the given classification where the denoted response occurred. The first datum presented for a given response, e.g., "Airsickness-Present," is the percentage of the hops where airsickness was present without qualification as to the severity (mild, moderate, or severe) of the response. The three following values describe the percent incidence of mild, moderate, and severe ratings, respectively, for the denoted questionnaire item. In the case of the vomit measure the breakdown is generally based upon the number of times the response occurred on a given flight. The student questionnaire tabulation also contains a line item describing the percent incidence of flights where the students reported that airsickness

Table 1

Percent incidence of airsickness and related flight questionnaire responses on the eighteen hops comprising the Squadron VT-10 flight syllabus. The student and instructor questionnaire data are listed separately with each datum shown below a given hop representing the percentage of the total hops flown of the given type where the denoted response occurred. The total column at the right represents the percent incidence of a given response based on all 5,394 hops flown by the 488 students comprising the study population.

FLIGHT QUESTIONNAIRE RESPONSES	INDIVIDUAL HOPS COMPRISING SQUADRON FLIGHT SYLLABUS																		
	FM1	FM2	FM3	FM4	FM5	IN1	IN2	IN3	IN4	IN5	IN6	VN1	VN2	VN3	VN4	F01	F02	F03	TOTAL
HOPS FLOWN-PERCENT OF TOTAL	7.4	7.5	7.4	7.6	7.0	5.0	4.6	4.6	4.4	4.7	5.0	5.8	5.1	5.1	5.2	5.2	4.7	4.8	100.
S-AIRSICKNESS-PRESENT	59.6	9.9	4.5	4.2	25.3	2.6	1.2	.8	1.2	1.6	2.2	7.4	4.0	5.9	3.7	48.6	48.6	41.2	16.2
S-AIRSICKNESS-MILD	29.4	7.4	3.3	3.7	24.4	2.2	1.2	.8	.8	.8	1.9	5.3	3.6	4.8	2.6	22.7	26.7	21.9	9.7
S-AIRSICKNESS-MODERATE	23.7	1.2	1.3	.5	9.8	.4	.0	.0	.4	.0	.4	.7	.4	.7	1.0	11.9	17.9	12.3	5.0
S-AIRSICKNESS-SEVERE	6.5	.2	.0	.0	1.3	.0	.0	.0	.0	.0	.0	1.1	.0	.4	.4	6.1	4.8	6.9	1.5
S-VOMITING-PRESENT	28.2	1.7	1.0	.5	14.9	.4	.0	.0	.4	.4	.4	1.5	.0	1.1	2.2	21.9	23.1	20.0	6.9
S-VOMITING-1 TIME	14.2	1.5	.0	.3	11.4	.0	.0	.0	.0	.4	.4	.4	.0	.7	1.4	12.6	11.2	9.6	3.8
S-VOMITING-2 TIMES	8.2	.2	.3	.3	2.7	.0	.0	.0	.4	.0	.0	.4	.0	.4	.7	5.3	7.6	6.2	1.9
S-VOMITING-3 OR MORE TIMES	5.7	.0	.0	.0	.0	.4	.0	.0	.0	.0	.3	.7	.0	.0	.0	4.3	4.4	4.2	1.2
S-PERF. DEGRADATION-PRESENT	41.6	4.4	2.8	2.7	20.7	2.6	1.2	.4	.0	1.2	1.9	4.0	2.5	3.3	3.9	24.1	33.9	38.4	10.7
S-PERF. DEGRADATION-MILD	21.2	3.7	1.5	2.2	14.9	2.2	1.2	.4	.4	1.2	1.5	2.6	2.2	1.8	3.2	12.6	22.3	18.1	6.5
S-PERF. DEGRADATION-MODERATE	15.5	.5	1.3	.5	5.3	.0	.0	.0	.4	.0	.4	.7	.4	1.1	.4	8.3	8.4	7.3	3.0
S-PERF. DEGRADATION-SEVERE	5.0	.2	.0	.0	.5	.4	.0	.0	.0	.0	.0	.7	.0	.7	.4	3.2	3.2	3.0	1.1
S-NERVOUSNESS-PRESENT	76.1	37.6	44.7	41.3	44.0	24.3	15.9	14.6	12.3	14.5	19.0	28.1	22.1	23.1	22.9	45.0	45.4	35.9	35.4
S-NERVOUSNESS-MILD	41.6	29.5	34.9	33.7	35.0	20.1	15.4	14.2	11.7	11.7	16.0	21.0	18.8	20.1	17.6	36.0	37.0	29.6	26.0
S-NERVOUSNESS-MODERATE	32.4	16.3	9.0	6.7	8.2	3.7	.4	.0	.4	2.3	2.6	7.7	2.9	2.2	4.5	6.6	7.2	5.4	7.7
S-NERVOUSNESS-SEVERE	2.0	2.0	.0	1.0	.0	.4	.0	.4	.4	.4	.4	1.5	.4	.7	1.1	.4	.4	.0	.0
S-MEDICATION USED ON HOP	1.2	4.2	4.0	3.7	5.0	1.9	.8	.4	.4	.4	.4	1.1	1.1	1.1	1.4	4.3	6.0	8.5	2.0
I-AIRSICKNESS-PRESENT	44.6	2.7	2.3	2.0	22.3	.4	.4	.4	.4	.4	.0	4.0	1.0	2.6	3.6	27.5	30.3	25.0	10.2
I-AIRSICKNESS-MILD	27.9	2.2	1.5	1.7	17.0	.0	.4	.4	.4	.4	.0	3.3	1.4	1.8	2.5	14.0	21.1	13.8	6.6
I-AIRSICKNESS-MODERATE	14.5	.2	.0	.0	4.0	.4	.0	.0	.0	.0	.0	1.5	.4	.4	1.1	10.8	6.0	7.7	2.9
I-AIRSICKNESS-SEVERE	2.2	.2	.0	.3	.5	.0	.0	.0	.0	.0	.0	.0	.0	.4	.0	2.5	3.2	3.5	.7
I-VOMITING-PRESENT	28.4	.7	1.3	.5	13.0	.4	.0	.4	.4	.4	.0	1.5	.4	1.1	2.5	20.1	21.5	20.0	6.6
I-VOMITING-1 TIME	14.2	.5	1.0	.3	10.1	.0	.0	.4	.0	.4	.0	1.1	.4	.7	2.2	12.9	12.4	11.2	3.9
I-VOMITING-2 TIMES	9.7	.0	.3	.3	2.9	.4	.0	.0	.4	.0	.0	.4	.0	.4	.4	4.7	6.4	6.5	1.9
I-VOMITING-3 OR MORE TIMES	4.5	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.5	2.0	2.3	.6
I-PERF. DEGRADATION-PRESENT	31.7	2.7	2.5	2.0	13.0	.7	2.4	.4	1.2	.0	.4	3.3	.7	1.1	2.5	19.6	21.5	20.4	7.5
I-PERF. DEGRADATION-MILD	21.7	2.2	2.3	1.7	8.8	.4	2.4	.4	.0	.0	.0	2.6	.7	.7	1.4	13.3	17.5	15.8	5.4
I-PERF. DEGRADATION-MODERATE	9.2	.2	.3	.3	4.0	.4	.0	.0	.4	.0	.0	.7	.0	.0	.7	4.7	2.9	2.7	1.7
I-PERF. DEGRADATION-SEVERE	.7	.2	.0	.0	.3	.0	.0	.0	.0	.0	.0	.0	.0	.4	.4	1.8	1.2	1.9	.4
I-NERVOUSNESS-PRESENT	44.9	30.4	23.9	17.0	18.3	10.4	8.9	6.9	8.3	9.0	9.3	12.1	9.4	9.5	24.3	21.2	26.7	19.6	17.9
I-NERVOUSNESS-MILD	36.9	24.0	19.1	14.5	17.0	8.2	7.3	5.7	7.1	7.4	8.2	10.7	8.7	8.4	18.0	18.3	22.3	16.9	15.1
I-NERVOUSNESS-MODERATE	8.0	6.2	4.8	2.5	1.3	2.2	1.6	1.2	1.2	1.6	1.1	1.1	.7	1.1	2.9	2.9	2.4	2.7	2.8
I-NERVOUSNESS-SEVERE	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.7	.0	.0	.0	.1
I-TURBULENCE-PRESENT	37.7	8.9	10.6	8.7	26.0	7.8	6.9	7.3	7.1	5.5	4.9	22.1	18.5	17.6	20.8	35.3	39.0	33.8	15.7
I-TURBULENCE-MILD	30.4	7.7	9.0	7.7	10.1	7.1	6.1	6.9	7.1	4.3	4.5	15.4	13.4	12.1	14.0	18.7	14.3	10.8	11.5
I-TURBULENCE-MODERATE	6.0	1.2	.0	1.0	10.3	.7	.0	.4	.0	.4	.4	5.9	4.0	5.5	6.5	11.5	29.1	25.8	5.0
I-TURBULENCE-SEVERE	1.2	.0	.0	.0	5.6	.0	.0	.0	.0	.0	.0	.7	1.1	.0	.4	5.0	15.5	17.3	2.0
I-PLT. GRADES-ISSUED ON HOP	99.3	90.0	99.0	98.7	99.2	99.6	99.6	99.6	99.2	98.0	98.5	100.	98.9	98.5	96.4	98.2	90.0	98.1	98.0
I-PLT. GRADES-UNSATISFACTORY	2.7	.2	.2	.3	.2	.2	.1	.3	.1	.3	.2	.0	.1	.1	.3	.2	.1	.0	.2
I-PLT. GRADES-BELOW AVERAGE	2.4	8.3	8.4	8.8	5.4	8.2	7.9	7.2	5.8	6.9	7.6	9.0	8.2	8.2	7.9	6.4	6.0	4.7	7.4
I-PLT. GRADES-AVERAGE	91.0	81.1	80.0	90.5	86.5	80.5	80.6	81.4	82.9	81.1	80.7	79.7	81.0	79.9	80.3	84.0	83.2	85.3	81.9
I-PLT. GRADES-ABOVE AVERAGE	3.0	10.4	10.5	10.7	7.9	11.2	11.4	11.0	11.2	11.7	11.6	11.4	10.7	11.0	11.9	8.7	8.0	10.0	10.5

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA

medication had been used. In the instructor tabulation separate listings are provided for flight turbulence and a breakdown of the grades issued on a given hop. The data presented in the total column at the extreme right of the table represent the percentage of the total hops flown (5,394) where the denoted responses were present.

As indicated in the Total column of Table I, the VT-10 students reported that airsickness (mild, moderate, or severe) occurred on 16.2 percent of the hops flown; their instructors estimated the incidence to be only 10.2 percent. For the overt symptom of vomiting, however, the student and instructor ratings were more nearly in agreement, as would be expected; the percentage of the total flights where vomiting occurred one or more times was reported as 6.9 by the students and 6.6 by the instructors. Airsickness of sufficient severity to degrade the inflight performance of the student was judged to be present on 10.7 percent of the total flights by the students and 7.5 percent by the instructors. Student nervousness, experienced either before or during a hop, was indicated on 35.4 percent of the hops by the students and only 17.9 percent by the instructors.

To highlight the difference between these response measures as a function of the specific hops comprising the VT-10 flight syllabus, selected elements of Table I have been plotted in Figures 3 through 9. In these figures each hop is identified with an

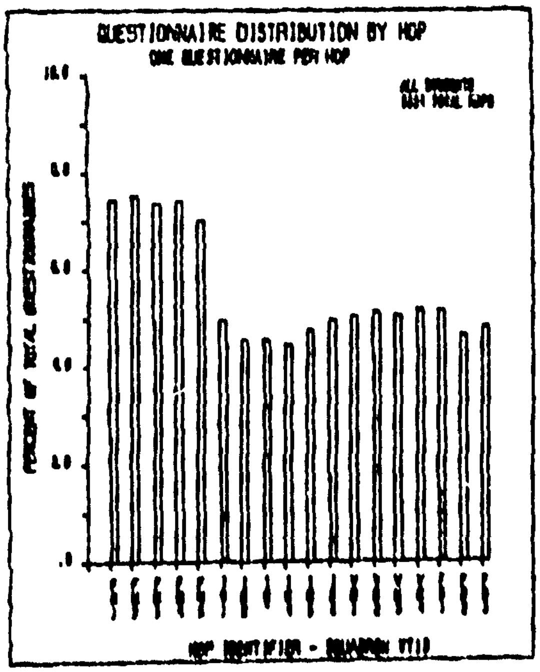


Figure 3

Plot of relative distribution of airsickness questionnaires received during the study as a function of the eighteen hops comprising the Squadron VT-10 flight syllabus. Each bar above a given hop corresponds to the percentage of the total number of questionnaires collected during the study that pertained to the specific hop. The left-to-right hop sequence shown corresponds in general to the sequence that the students flew the hops, although there were exceptions within each hop series.

abbreviated code that is detailed in Appendix A. The labeling sequence in these figures reading from left to right follows, in general, the sequence that the students actually flew the hops, although there were variations from student to student. The extent and distribution of the basic data available for analysis on an individual-hop basis are depicted in Figure 3 where the number of questionnaires collected for a given hop is expressed as the percentage of the total number (5,394) of questionnaires received. It should be noted that the number of questionnaires collected for each of the first five familiarization hops (FM1 through FM5) exceeds the number collected for each of the following 13 hops. This arises because the students selected for assignment to MAFB fly only the first five familiarization hops, while all other students fly the entire 18-hop syllabus. On the average, approximately 400 questionnaires were completed on each of the familiarization hops, and about 260 questionnaires were obtained from each of the remaining hops. Variations in the exact number of questionnaires per hop are due to less than 100 percent return which was compensated by occasional repeat hops. Of the 5,394 questionnaires received, 326 (about 6 percent) involved students repeating a hop previously flown.

In Figure 4 the student and instructor ratings of airsickness incidence are compared on an individual-hop basis. Figure 4A plots the incidence of airsickness, regardless of degree of severity, that occurred on a given hop expressed as the percentage of the total times airsickness occurred relative to the total number of times the hop was flown. Figures 4B, 4C, and 4D depict the percent incidence of hops where airsickness was present to a mild, moderate, and severe degree, respectively. These data generally indicate that both the incidence and severity of airsickness were greatest on FM1, the first familiarization flight. Of the total number of FM1 flights, the students indicated that 59.6 percent of the hops produced airsickness, 28.2 percent resulted in vomiting one or more times (Figure 5), and 41.6 percent caused performance degradation due to airsickness (Figure 6). The incidence of nervousness, either before or during flight, was also greatest for this initial flight (Figure 7).

Airsickness effects were also high on the fifth familiarization hop (FM5) but not to the extent experienced on FM1. The FO1 through FO3 series of hops, generally flown at the very end of the flight syllabus, also produced considerable motion stress. In terms of the maximum severity of the airsickness symptoms (Figure 4D), the maximum number of times vomiting occurred (Figure 5D), and the maximum performance degradation (Figure 6D), hops FM1, FO1, FO2, and FO3 produced the greatest stress ratings by both the students and the instructors. Severe nervousness ratings (Figure 7D) were not particularly pronounced, however, for this particular set of flights. However, the students reported a relatively high incidence of nervousness present (Figure 7A) as compared to the three airsickness-related response measures. The pattern of incidence by hops apparent in Figure 7 only approximately matches the more distinctive patterns noticeable in Figures 4, 5, and 6.

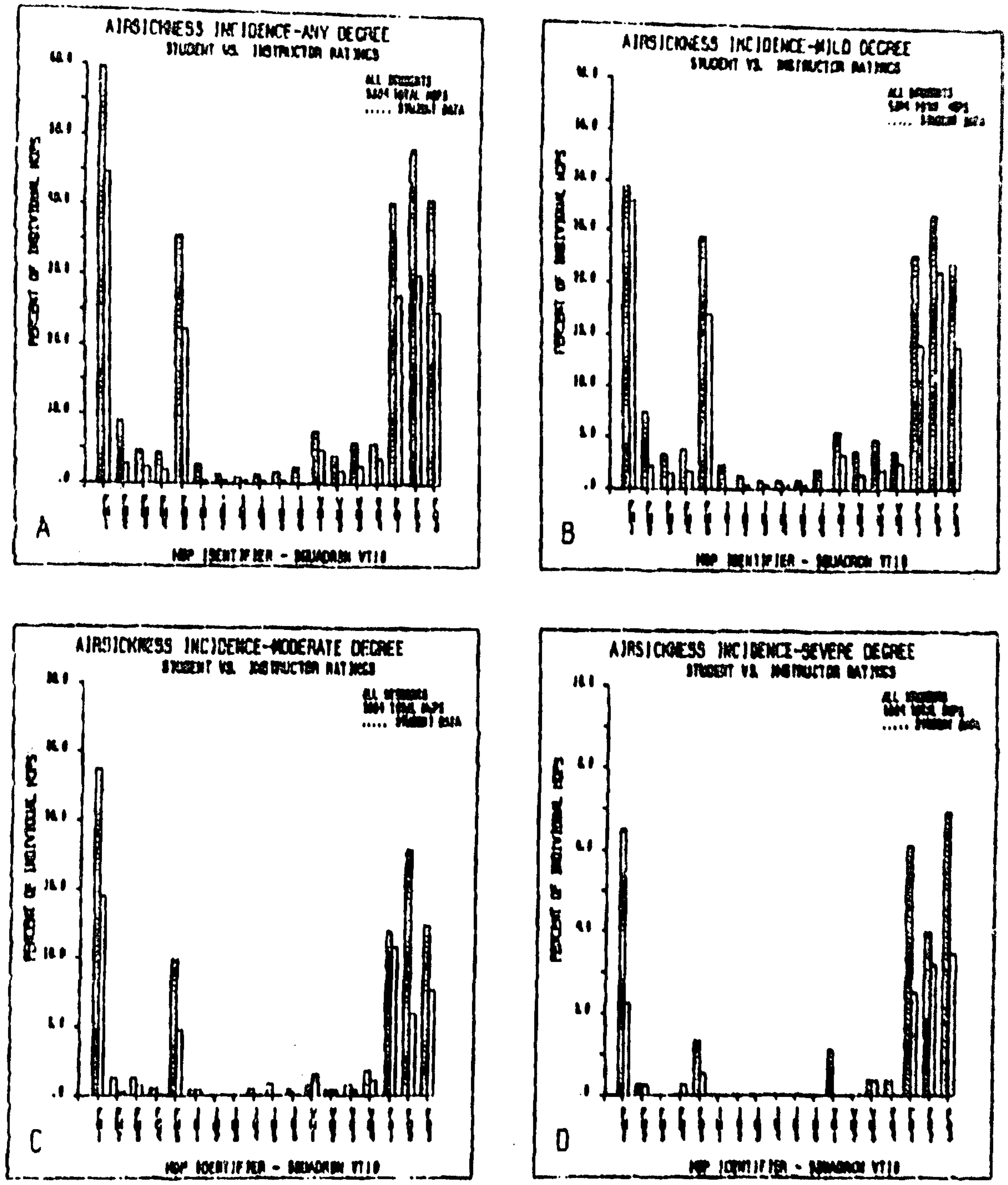


Figure 4

Comparison of student and instructor ratings of airsickness incidence and severity as a function of the individual VT-10 hops. The incidence of airsickness of any degree (mild, moderate, or severe) is shown in A; the incidence of mild, moderate, and severe degrees of airsickness in B, C, and C, respectively. In each case, incidence is expressed as the percentage of the total number of hops flown of a given classification where the denoted response occurred. In general, the instructor judgments of airsickness incidence and severity underestimate those provided by the students. These data indicate that motion stress was greatest on hops FM1, FM5, and PO1 through FO3.

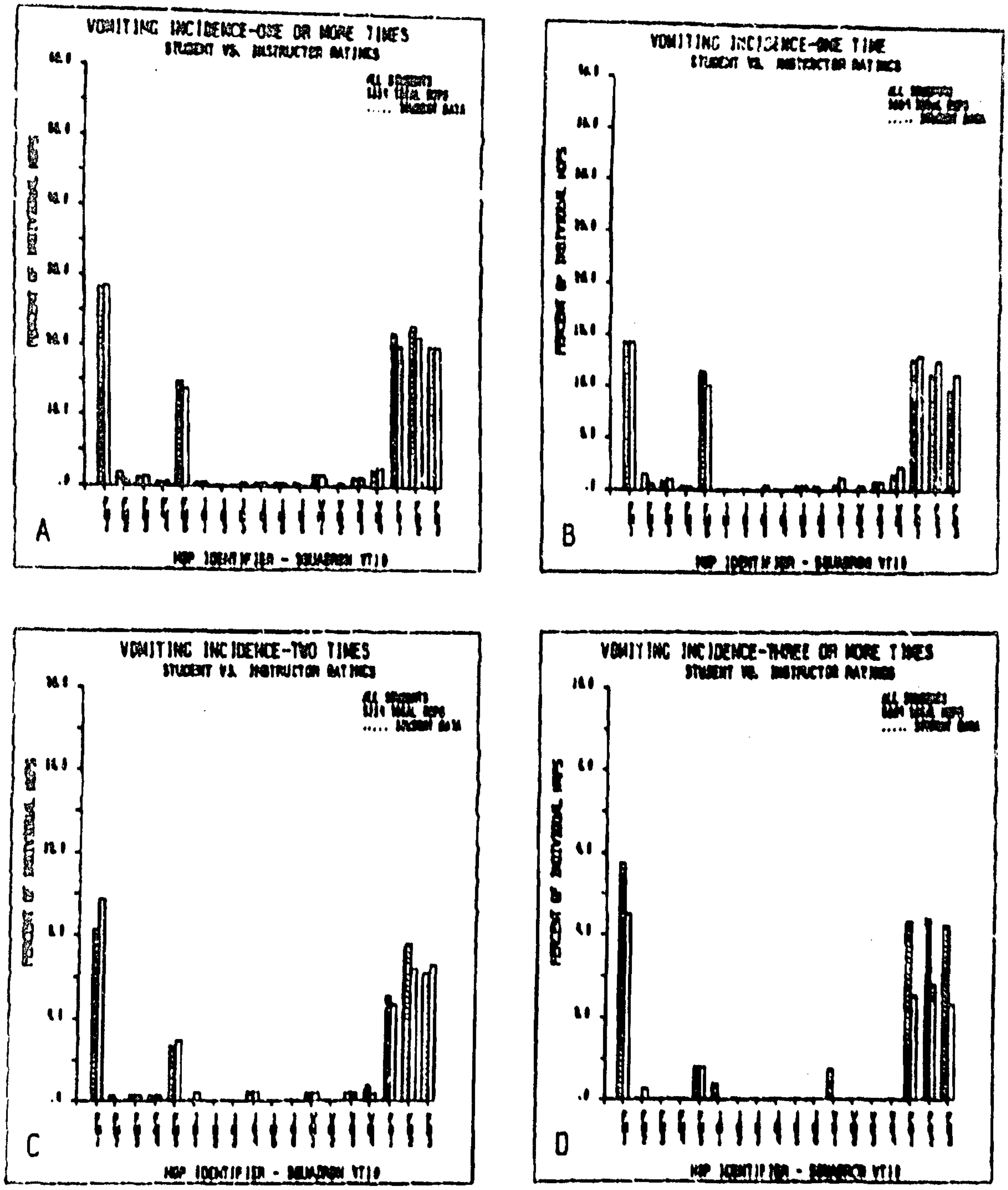


Figure 5

Comparison of student and instructor ratings of vomiting incidence as a function of the individual hops. The percent incidence of hops resulting in students vomiting one or more times is shown in A; the incidence of hops where the students vomited one, two, or three or more times is shown in B, C, and D, respectively. As with Figure 4D, the incidence of repeated vomiting fell significantly on hop FM5 following FM1. but rose again on hops FO1 through FO3, which generally occurred at the very end of the flight syllabus.

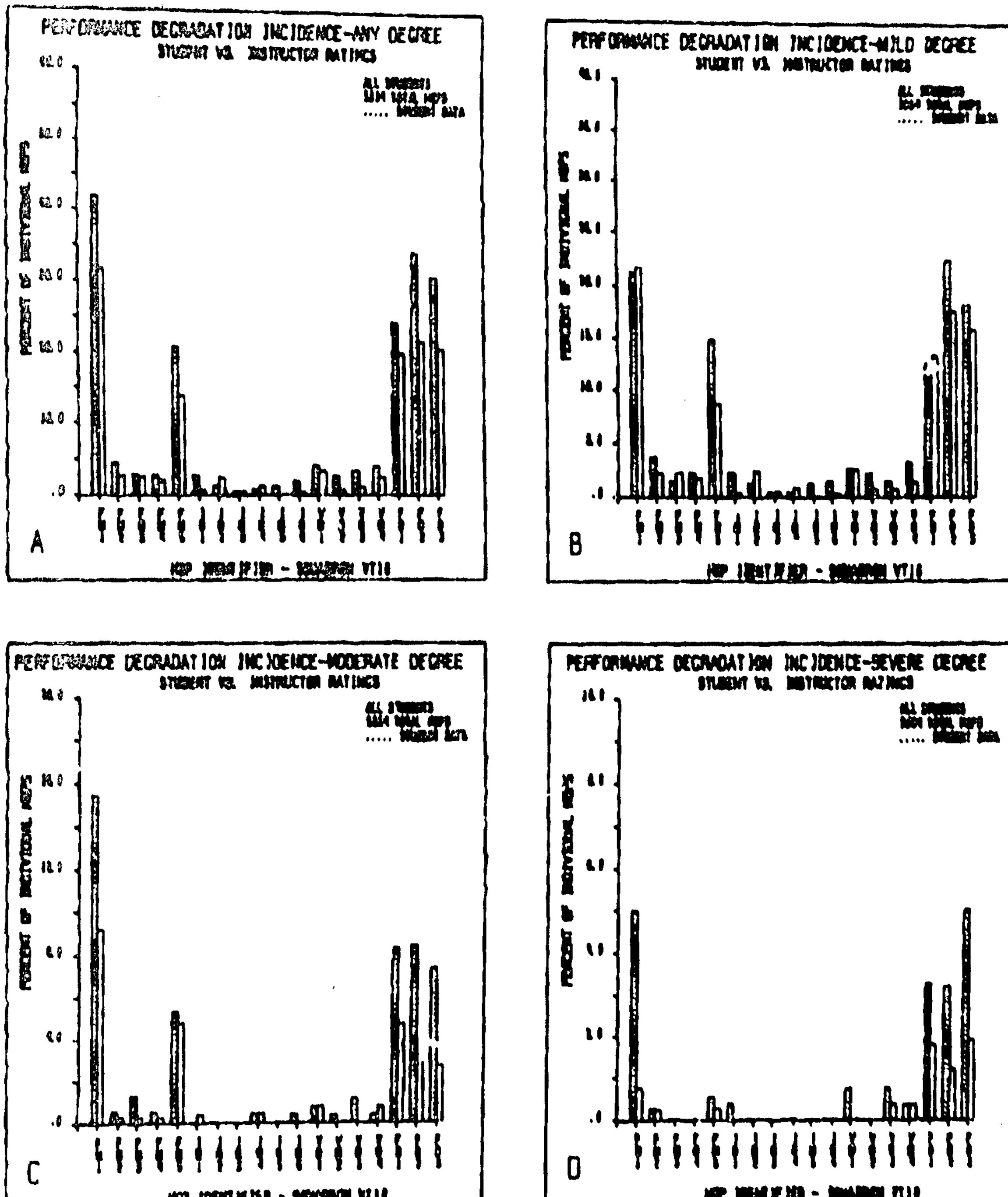


Figure 6

Comparison of student and instructor ratings of inflight performance degradation caused by airsickness as a function of the individual hops. In general, the students overrated the extent of their performance degradation as compared to the instructor judgments. Hops FM1, FM5, and FO1 through FO3 remain the principal stress flights.

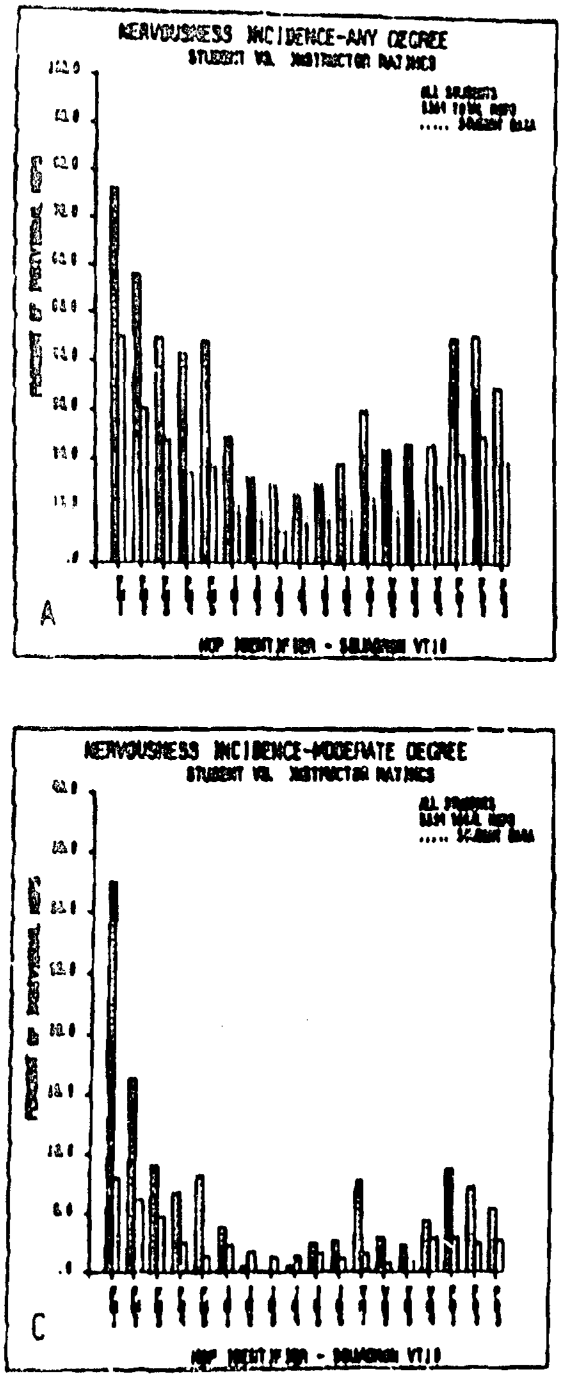


Figure 7

Comparison of student and instructor judgments of student nervousness before or during a given flight as a function of the individual hops. As compared to the Figures 4, 5, and 6 data, the incidence of nervousness was more evenly distributed over the flight syllabus. There was a gradual decline in nervousness following the first flight, followed by a slight rise at the end of the flight program as marked by flights FO1 through FO3.

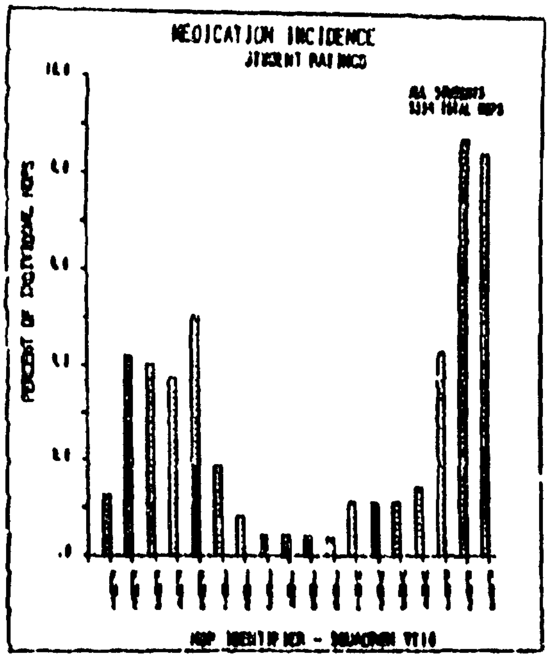


Figure 8

Percent incidence of flights where students reported using airsickness medication. The frequency of medication usage increased considerably on the four familiarization flights following the first flight (FM1) where the incidence of airsickness was nearly 60 percent (see Figure 4A). Usage on the IN and VN series of hops then fell, followed by a rise on the last series (FO) of hops.

Figure 8 is a plot of the percent incidence of airsickness medication usage as reported by the students. These data indicate that the use of such medication following the first familiarization hop (FM1) increased considerably on the subsequent four familiarization hops (FM2 through FM5). The use of medication on the IN and VN series of hops fell to a relatively low level but rose again on the FO series of hops. This reported usage of medication during the late phases of the training program requires further investigation since this practice tends to allow airsick susceptibles to continue in the program without the natural screening intended by training command personnel. However, as will be discussed in a later section, the number of NFO students reporting the usage of medication composed a small percentage of the total Squadron VT-10 population.

Figure 9 is a summary plot of the turbulence or roughness-of-air data provided by the instructor groups following each flight. As indicated by Figure 9A, the instructors considered turbulence to be present to a significant extent on the five hops producing the greatest airsickness stress; i.e., FM1, FM5, and FO1 through FO3. The VN series of flights was also considered to have turbulence present to some degree. The intent of this element of the questionnaire was to obtain background information on any possible relationship between flight turbulence due to atmospheric conditions and airsickness

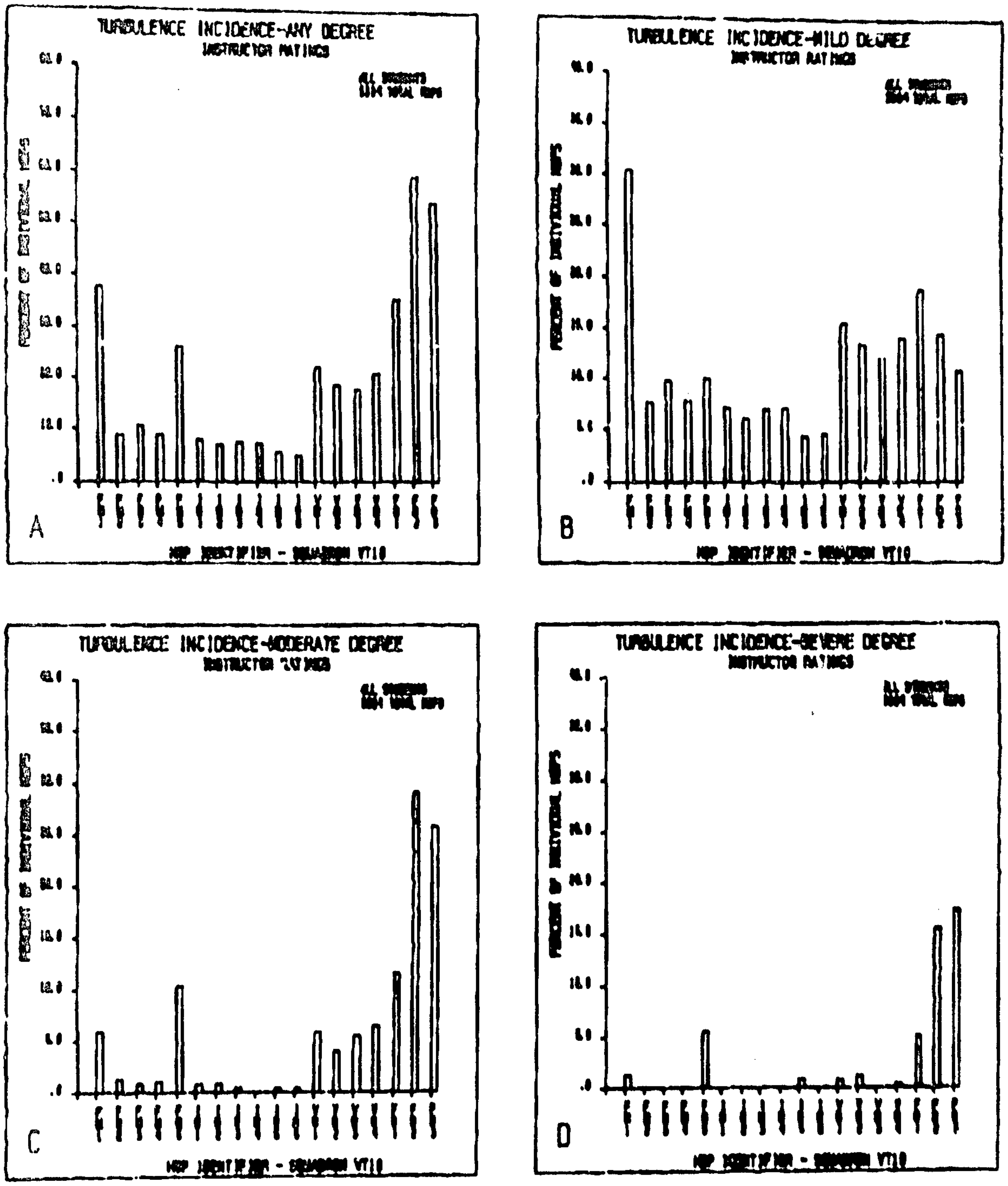


Figure 9

Percent incidence of turbulence (rough air or pilot technique) as a function of the individual hops. These data, derived from instructor ratings, were not consistent in that certain instructors incorporated g forces associated with tactical maneuvers performed on a given flight into their definition of roughness of air. The problem probably arose from inclusion of the phrase, "or pilot technique," in the instructor questionnaire (see Figure 2 - bottom). This is reflected to a certain degree in the FM1, FM5, and FO1 through FO3 data in this figure.

incidence. However, during the course of the study it was found that certain instructors based their roughness-of-air judgments upon the over-all magnitude of the flight forces produced by the hop maneuvers associated with a given hop rather than simple atmospheric turbulence. This interpretation was due to the inclusion of the words, "pilot technique," in the roughness-of-air item included in the instructor questionnaire (Figure 2 - bottom). In this context the turbulence data listed in Table I and plotted in Figure 9 are probably highly compromised by the level of the flight forces produced by the tactical maneuvers required on a given hop.

The flight grade data tabulated in Table I are plotted as a function of the individual hops in Figure 10. The squadron grading protocol was such that an instructor issued one of four grades (average, above average, below average, or unsatisfactory) for each of the flight performance tasks to be practiced on a given hop. The total number of grades issued on a given hop could range from one (FM1) through ten or more, depending upon the complexity of the hop. The percentage data plotted in Figure 10 refer to the total number of grades issued on a given hop. These data indicate that the distribution of flight grades across hops was relatively constant, with the exception of FM1 which involved only one grade per student.

As mentioned previously, the sequence in which the students flew the 18 hops comprising the VT-10 flight syllabus generally followed the left-right sequence shown in Figures 4 through 10. However, there were exceptions where students flew hops in different sequences, particularly in the IN and VN series of hops. Without exception, however, the FM flights always preceded the FO tactical maneuver hops, with a considerable number of IN and VN flights flown in between these two series of hops. In this respect, a first inspection of the airsickness (Figure 4) and vomiting (Figure 5) data would indicate that little adaptation to reduce airsickness occurred in the student group over the entire length of the training program. However, the FO series of flights involved tactical missions that produced a high level of motion stress compared to all hops, with the exceptions of FM1 and FM5. For these two familiarization hops, as deduced from interviews with different instructors, the tactical maneuvers performed on FM5 were considered to produce a much greater motion stress than the maneuvers performed on FM1. Although FM5 was the greater stressor, the airsickness effects observed for this flight were of less severity than those associated with FM1, indicating some degree of initial adaptation. For example, on FM1 airsickness incidence was 59.6 percent, which then decreased to 35.5 percent on FM5. Similarly, vomiting incidence on FM1 was 28.2 percent, which then fell to 14.9 percent on FM5. The rise in airsickness effects during the FO series of hops which occurred at the end of the flight syllabus emphasizes the point that adaptation effects cannot be deduced from a simple sequential analysis of hops flown, but must, instead, derive from an evaluation of the relative stress level of the individual hops comprising a given flight syllabus.

AIRSICKNESS INCIDENCE AND SEVERITY: STUDENT FREQUENCY ANALYSIS

The same questionnaire data used to develop the Table I analysis of airsickness incidence for each hop were also examined to determine the relative contribution of

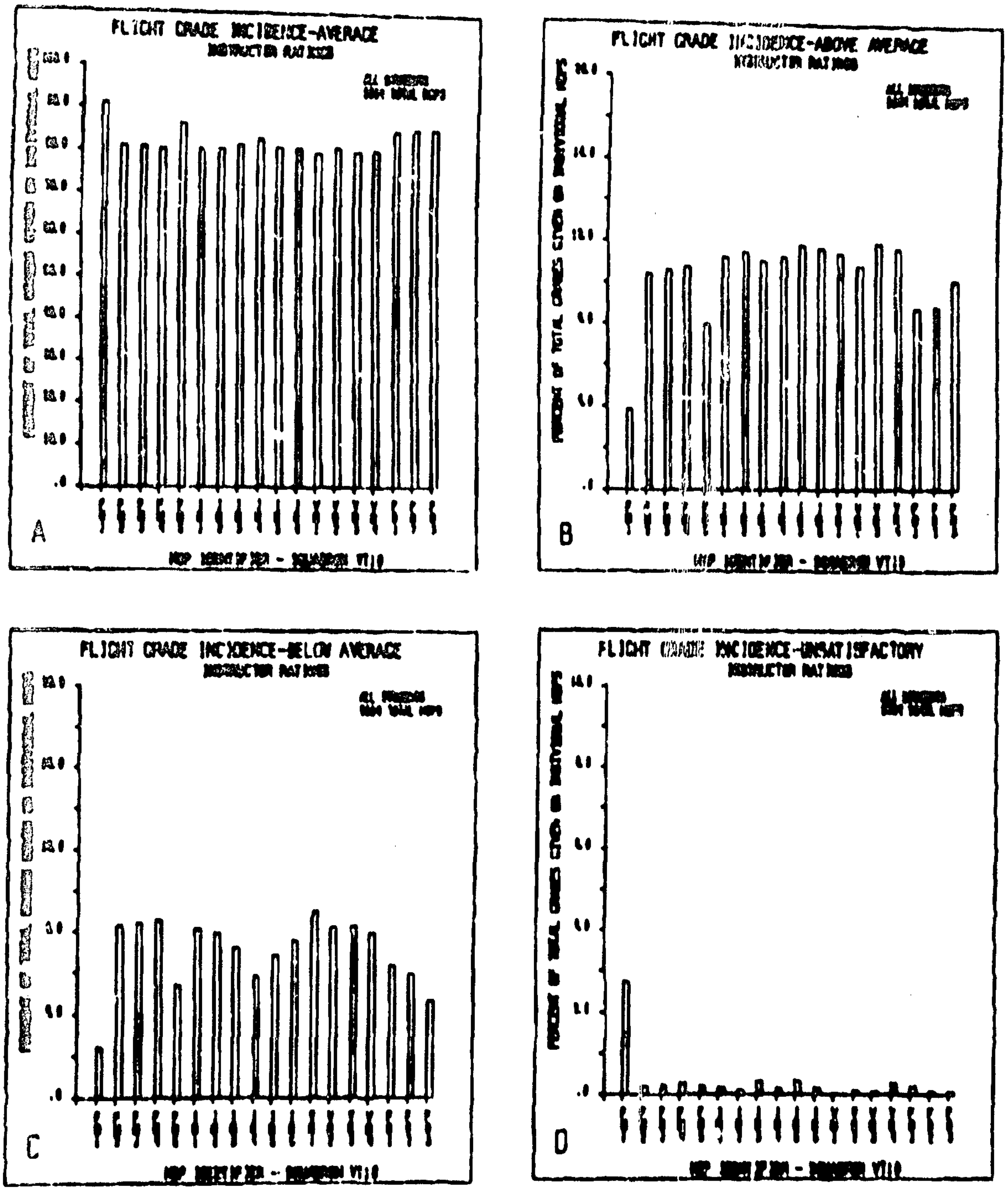


Figure 10

Percent incidence of average (A), above average (B), below average (C), and unsatisfactory (D) flight grades for the individual hops. The grading system is based upon assigning one of these four grades to each task performed on a given hop where the number of tasks graded varies from hop to hop. Each datum plotted in this figure represents the percentage of the total number of grades given on a given hop where the denoted grade was issued. The different grades were relatively evenly distributed over the flight syllabus.

individual students who experienced repeated airsickness. In Table I the incidence data presented below each hop corresponds, in general, to the number of students experiencing airsickness on that hop, but these data were influenced by a small number of students who had to repeat hops for one reason or another. In this sense the incidence data in Table I, when interpreted relative to the percentage of students who were airsick on a given hop, would be on the high side of the true percentage figure. In this case total incidence relative to all of the hops flown does not have a direct relationship with the number of students experiencing airsickness since airsickness was not evenly distributed across either the hops flown or, equally important, the student population.

To examine incidence on an individual-student basis, the data were analyzed to determine the number of students who experienced a given response a repeated number of times during the course of the entire VT-10 training program. Table II is a tabulation of the results of this analysis for the principal inflight elements under study. Each datum in this table below a given column heading denotes the percentage of the 408 students who experienced a given response the number of times indicated by the column header. The total column at the extreme right of each row in the table denotes the percentage of the total number of students who experienced the given response one or more times. These total data indicate that 74.5 percent of the students were airsick on one or more flights during their VT-10 training, 39.2 percent vomited on one or more hops, and 58.6 percent experienced performance degradation due to airsickness on one or more hops. As shown by the individual column data in Table II, a small percentage of students who were repeatedly airsick made quite significant contributions to the over-all airsickness incidence rate. Some students displayed extreme perseverance in that one individual reported being airsick on 17 hops and seven individuals reported vomiting on six or more hops. Table II, like Table I, reflects the lower magnitude of the instructor ratings as compared to those of the students.

To emphasize the multiple contributions of a small number of students to the over-all airsickness incidence data, the student- and instructor-based airsickness, vomiting, performance degradation, and nervousness data of Table II have been plotted in cumulative frequency distribution form in Figure 11. The least susceptible members of the student population are identified in this figure by the intersection of the distribution curve with the ordinate axis. In effect, 25.5 percent of the students reported that they never experienced airsickness during training, 60.8 percent reported that they never vomited, 41.4 percent never reported any performance degradation due to airsickness, and 11.5 percent indicated that they never experienced nervousness. Arbitrarily defining the most susceptible students as those in the upper 10 percent (decile) of the Figure 11 distributions results in the following observations relative to the student questionnaire data: For the airsickness measure, that 10 percent of the population with the greatest incidence of repeated airsickness experiences is defined by students who were airsick on five or more flights. For the vomit measure the upper decile population is marked by students who vomited on three or more flights. The same applies for the performance degradation measure. In essence, tests of motion sickness sensitivity would be quite useful if they could successfully identify individuals comprising these susceptible subpopulations.

Table 11

Relative distribution of students experiencing repeated airsickness a different number of times during flight training in Squadron VT-10. Each datum listed beneath a given column number represents the percentage of the total student population (N = 408) that experienced a given response the denoted number of times. The total column at the right represents the percentage of the total population that experienced a given response one or more times during flight training.

FLIGHT QUESTIONNAIRE RESPONSES	NUMBER OF TIMES RESPONSE EXPERIENCED 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18+	TOTAL
S-AIRSICKNESS-PRESENT	24.0	16.4	10.0	9.3	5.9	4.2	1.7	1.0	.5	.5	.0	.0	.0	.0	.0	.0	.2	.0	74.9
S-AIRSICKNESS-MILD	27.9	18.4	7.6	3.9	2.0	1.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	62.9
S-AIRSICKNESS-MODERATE	20.6	10.5	4.7	2.0	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	38.2
S-AIRSICKNESS-SEVERE	7.0	3.2	.7	.5	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	12.5
S-VOMITING-PRESENT	15.9	9.6	5.4	5.4	1.2	1.0	.2	.2	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	39.2
S-VOMITING-1 TIME	16.2	9.6	3.4	.2	.2	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	30.1
S-VOMITING-2 TIMES	14.0	3.2	.7	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	18.4
S-VOMITING-3 OR MORE TIMES	8.1	2.5	.5	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	11.2
S-PERF. DEGRADATION-PRESENT	24.3	13.7	8.1	4.9	3.9	1.7	.2	.7	.0	.0	.0	.0	.0	.2	.0	.2	.0	.0	58.6
S-PERF DEGRADATION-MILD	28.2	12.0	3.7	2.7	.5	1.0	.2	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	48.5
S-PERF. DEGRADATION-MODERATE	19.1	6.6	1.2	1.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	27.9
S-PERF. DEGRADATION-SEVERE	6.9	1.5	.7	.2	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	9.6
S-NERVOUSNESS-PRESENT	16.7	10.0	9.0	9.0	13.7	3.7	2.9	4.9	1.5	4.2	1.0	1.2	1.5	1.2	1.5	1.2	2.2	.7	88.5
S-NERVOUSNESS-MILD	19.6	13.5	11.8	10.5	5.4	4.4	2.5	3.2	1.7	2.2	1.7	1.5	1.2	1.5	.2	.7	.5	.0	82.1
S-NERVOUSNESS-MODERATE	25.0	12.5	4.9	3.2	2.0	1.0	.5	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	49.8
S-NERVOUSNESS-SEVERE	4.4	2.0	.2	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	6.9
S-MEDICATION USED ON HOP	2.0	3.4	1.6	1.7	[illegible]	.7	.7	.2	.2	.2	.0	.0	.0	.0	.0	.0	.0	.0	10.0
I-AIRSICKNESS-PRESENT	22.0	15.0	9.1	3.2	4.4	.7	1.0	.7	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	57.1
I-AIRSICKNESS-MILD	20.7	14.0	7.6	1.7	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	49.8
I-AIRSICKNESS-MODERATE	16.2	6.6	1.7	.5	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	23.2
I-AIRSICKNESS-SEVERE	4.4	1.7	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	6.6
I-VOMITING-PRESENT	16.9	9.3	[illegible]	4.7	2.7	.2	.2	.2	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	38.7
I-VOMITING-1 TIME	16.7	8.6	3.2	.5	.7	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	30.1
I-VOMITING-2 TIMES	12.7	3.7	1.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	18.1
I-VOMITING-3 OR MORE TIMES	5.1	1.2	.2	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	7.1
I-PERF. DEGRADATION-PRESENT	21.3	12.3	5.4	[illegible]	2.7	.7	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	46.8
I-PERF. DEGRADATION-MILD	23.0	11.5	4.4	2.2	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	41.9
I-PERF. DEGRADATION-MODERATE	12.0	3.2	.5	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	16.9
I-PERF. DEGRADATION-SEVERE	2.7	.7	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	3.7
I-NERVOUSNESS-PRESENT	25.7	17.9	13.7	9.3	3.9	4.2	2.0	1.7	.7	1.0	.5	.0	.2	.0	.0	.0	.0	.0	80.9
I-NERVOUSNESS-MILD	25.7	18.9	13.6	6.6	3.4	2.0	.5	1.7	.5	.2	.2	.0	.2	.0	.0	.0	.0	.0	75.3
I-NERVOUSNESS-MODERATE	17.4	4.9	2.0	.7	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	25.2
I-NERVOUSNESS-SEVERE	.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.7
I-TURBULENCE-PRESENT	20.3	16.2	13.0	10.3	8.3	7.1	2.9	1.3	.7	.5	.0	.0	.0	.0	.0	.0	.0	.0	80.9
I-TURBULENCE-MILD	27.2	16.5	12.3	6.1	2.0	1.3	1.0	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	67.4
I-TURBULENCE-MODERATE	21.0	13.0	4.9	2.0	.2	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	44.1
I-TURBULENCE-SEVERE	14.0	6.6	1.7	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	22.3

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA

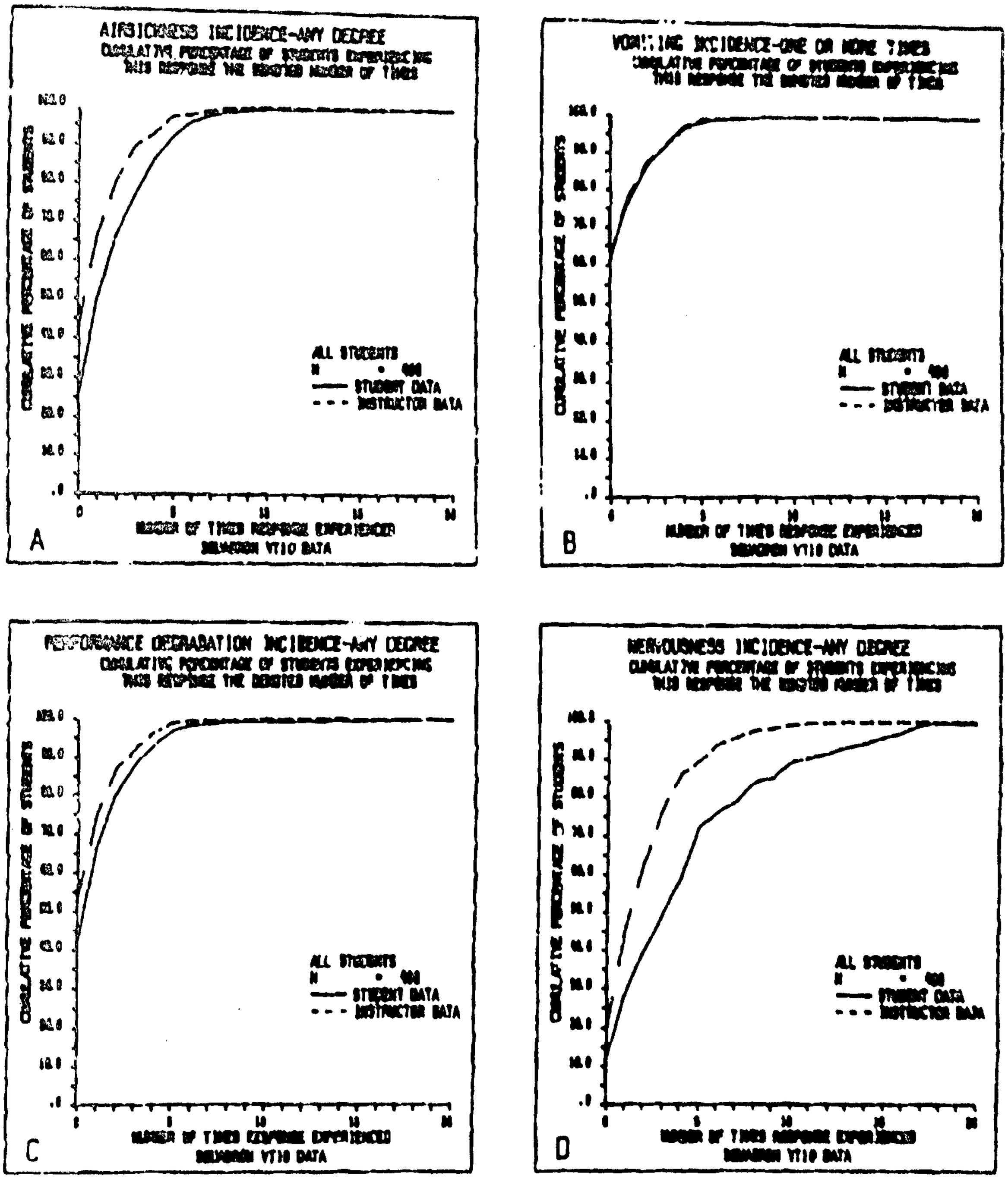


Figure 11

Normalized cumulative frequency distribution of students experiencing airsickness (A), vomiting (B), performance degradation (C), and nervousness (D) a different number of times during the course of their flight training, based upon both student (solid line) and instructor (dashed line) data. With the exception of vomiting, the instructor judgments of the number of students experiencing a given response underestimated the student judgments.

Another set of observations pertinent to the future comparison of these Squadron VT-10 student frequency data with similar data derived from advanced and fleet readiness squadrons involves the number of students contributing to the total incidence of airsickness that occurred on the hops flown. The Table I and Table II data can be related to show that 50 percent of the hops where airsickness occurred was accounted for by less than 19 percent of the students; 50 percent of the hops where vomiting occurred was accounted for by only 10 percent of the students; 50 percent of the hops where performance degradation occurred was accounted for by less than 14 percent of the students; and 50 percent of the hops where nervousness occurred was accounted for by only 17 percent of the students.

Normalized cumulative frequency distributions of the same form are also plotted for student reports of medication usage in Figure 12A and for instructor ratings of turbulence or roughness of air in Figure 12B. The significance of the medication usage plot is that only 10.8 percent of the students reported using medication during training. Of this total (44 students), 11 students reported using medication on five or more hops. In effect, the incidence of medication usage shown in Table I and plotted in Figure 8 was accounted for, in great part, by a very small number of students. The turbulence data show that the repeated exposure to roughness of air was more evenly distributed over the population.

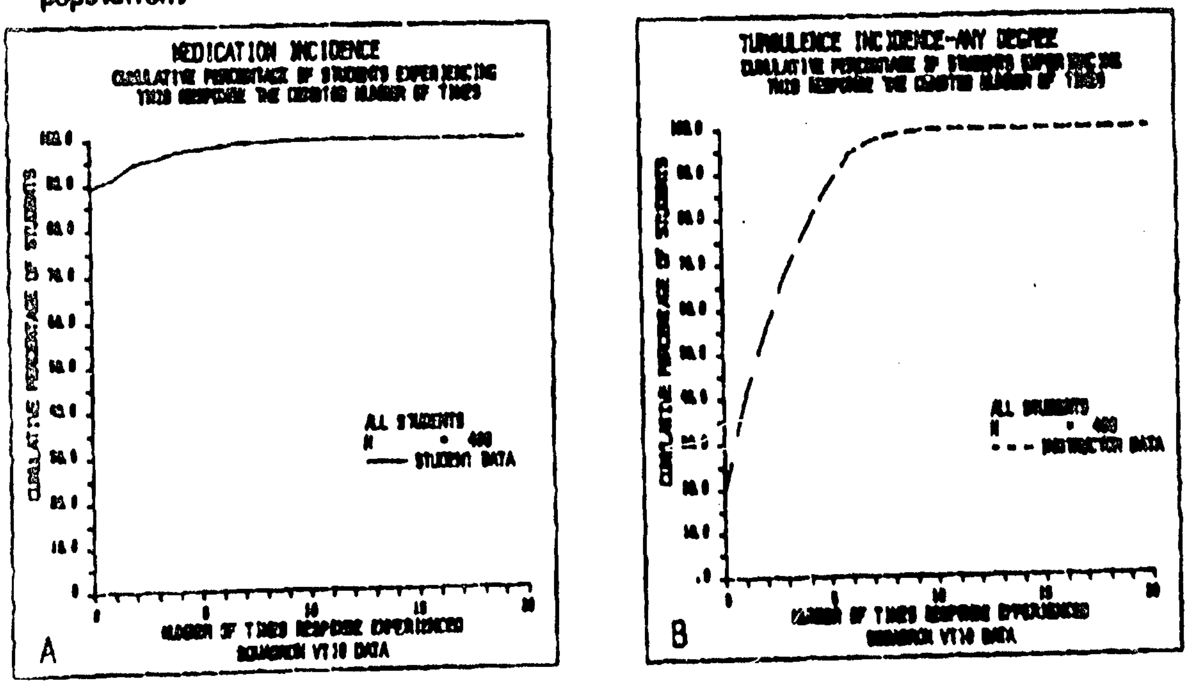


Figure 12

Normalized cumulative frequency distribution of students utilizing medication on a repeated basis (A) and students experiencing turbulence or roughness of air on one or more flights (B). Note that the incidence of medication usage shown in Figure 8 was accounted for by only 10 percent of the total student population, as indicated in A. Multiple exposure to turbulence was more evenly distributed over the population.

INDIVIDUAL STUDENT PERFORMANCE: AIRSICKNESS INDICES

To develop a method of comparing the performance of individual students over the entire course of their flight training in Squadron VT-10, unweighted and weighted indices were calculated for the principal elements of the airsickness questionnaire, using both the student and instructor ratings. Specifically, for each student five unweighted and five weighted indices of performance were calculated, using the airsickness, vomiting, performance degradation, nervousness, and medication usage components of the student questionnaires as measurement references. For the instructor data five unweighted and five weighted indices were calculated, using the airsickness, vomiting, performance degradation, nervousness, and turbulence components of the instructor questionnaire as reference. These indices have the immediate function of allowing the comparison of different student groups within a given squadron. They are also intended to serve the further function of relating an individual's early performance with subsequent performance in advanced and fleet readiness squadrons.

The unweighted indices for the questionnaire responses to be analyzed represent the percentage of the total number of flights flown by a given student where the denoted response occurred. For these indices no weight is given to the severity of the response. The unweighted index is calculated for a given student as

$$1)\ \text{RESPONSE INDEX (UNWEIGHTED)} = \frac{\text{No. Flights Response Experienced}}{\text{Total No. Flights Flown}} \times 100$$

To illustrate, if a student flew a total of 18 hops and reported that airsickness symptoms were present to some degree (i.e., mild, moderate, or severe) on 9 hops, the unweighted airsickness index for this individual would be 50.0. If a student never experienced airsickness, his index would be 0.0. Correspondingly, a maximum value of 100.0 for this index denotes a student who was airsick on all of the hops that he flew. This method of calculation of the unweighted indices applies to each of the five student questionnaire responses and to each of the five instructor responses as listed above.

The weighted indices calculated for the same ten questionnaire responses assign a linear weight of 0, 1, 2, and 3 to the four magnitude ratings associated with all but the medication usage item. For example, if a student reported that he was not airsick on a given hop, he would have a response rating of 0.0 for this hop; students who experienced mild, moderate, or severe airsickness symptoms would be given response ratings of 1.0, 2.0, and 3.0, respectively, for the hop. These response ratings were summed for each individual and used to calculate a weighted index, also normalized to have a maximum value of 100, as follows:

$$2)\ \text{RESPONSE INDEX (WEIGHTED)} = \frac{\text{Sum (Individual Flight Response Ratings)}}{\text{Total No. Flights Flown}} \times \frac{100}{3}$$

Accordingly, a student who was never airsick would have a weighted airsickness index of 0.0; a student who was severely airsick on all of his flights would have a weighted index of 100.0; a student who was mildly airsick on 50 percent of his hops would have an index of 16.7; and a student who was severely airsick on 50 percent of his hops would have an index of 50.0. In the case of the medication usage element of the student questionnaire, a response rating of 0 was assigned to the item if medication was not used on the flight and 1 if used. The weighted index for this response was also normalized to a maximum value of 100.0, thus resulting in the unweighted and weighted indices for this one item being identical.

The resulting group statistics for these individually calculated response indices are tabulated in Table III. Response variables 1 through 5, and 6 through 10, in this table describe the five unweighted and five weighted indices, respectively, derived from the student questionnaire data; variables 11 through 15, and 16 through 20, correspond equivalently to the unweighted and weighted indices derived from the instructor questionnaire data. Although the Table III statistics are based upon all 408 students included in the study, response indices were calculated for only those students who had filled out four or more questionnaires. Statistical data for variables 21 and 22, representing the final academic and flight grades received by the students graduating from VT-10, were not included in this particular table. The reason lies in the fact that the recorded grades received by the graduating students assigned to MAFB were based upon only the five familiarization hops (FM1 through FM5), while the grades recorded for the students assigned to the VT-86 and ATDS squadrons were based upon the thirteen additional hops flown by this latter group.

Statistical parameters calculated for each variable listed in Table III include the group mean, standard deviation of the observations, standard error of the mean, minimum value observed, maximum value observed, group median, the Kolmogorov-Smirnov deviation statistic, and the total number of observations included in the data base. The unweighted, student-based indices indicate that for this population, the mean or average student experienced airsickness on approximately 18 percent of the hops flown, vomited one or more times on 7.8 percent of the hops, experienced inflight performance degradation due to airsickness on 12 percent of the hops, and reported the presence of nervousness on over 40 percent of the hops. The equivalent unweighted indices calculated from the instructor data indicate considerably lower mean values for the same indices, with the exception of the vomit variable. The same relationship applies to the weighted indices presented in Table III. The mean value of approximately 3.5 for the medication usage index denotes a relatively low utilization of airsickness medication for the group. The mean unweighted turbulence index indicates that the instructors considered 20 percent of the hops involved roughness of air (turbulence and stressful flight forces).

The interpretation of the mean values of these 20 response indices as numbers describing the response of an "average student" is highly limited since the distributions of the response indices for the group are generally skewed toward the lower values. This is demonstrated by the median values shown in Table III which consistently fall below the mean. The non-Gaussian nature of the response indices is confirmed by the deviation statistic presented next to the median column in Table III. A Kolmogorov-Smirnov one-sample test of goodness of fit (10) was applied to the data where the normalized cumulative

Table III

Statistical listing of the flight response indices and laboratory test scores for the Squadron VT-10 study population. The flight indices (see text) for the individual students were calculated on the basis of all flights flown during training. Data presented for each response variable include the mean, standard deviation, standard error of the mean, minimum, maximum, median, and total number of students. In addition, the deviation-statistic associated with the nonparametric Kolmogorov-Smirnov one-sample test of goodness of fit of the distribution of the observed data to the distribution of an equivalent theoretical Gaussian population is listed at the right.

RESPONSE VARIABLE NO.	DESCRIPTION	STATISTICAL PARAMETERS MEAN	S.DEV.	S.ERR.	MIN	MAX	MEDIAN	N	DEV
1	S-AIRSICKNESS INDEX-UW	10.0	17.9	.9	.0	100.0	16.7	391	.120
2	S-VOMITING INDEX-UW	7.0	12.4	.6	.0	60.0	.0	391	.360
3	S-P.DEGRADATION INDEX-UW	12.1	15.9	.8	.0	100.0	8.9	391	.220
4	S-NERVOUSNESS INDEX-UW	40.1	32.1	1.6	.0	100.0	33.3	391	.130
5	S-MEDICATION INDEX-UW	3.5	13.5	.7	.0	100.0	.0	391	.520
6	S-AIRSICKNESS INDEX-W	9.0	10.4	.5	.0	60.0	6.7	391	.170
7	S-VOMITING INDEX-W	4.2	7.2	.4	.0	38.9	.0	391	.300
8	S-P.DEGRADATION INDEX-W	6.0	8.7	.4	.0	60.0	2.0	391	.220
9	S-NERVOUSNESS INDEX-W	17.2	15.5	.8	.0	91.7	13.3	391	.160
10	S-MEDICATION INDEX-W	3.5	13.5	.7	.0	100.0	.0	391	.520
11	I-AIRSICKNESS INDEX-UW	11.0	14.5	.7	.0	70.0	5.9	391	.230
12	I-VOMITING INDEX-UW	7.5	12.2	.6	.0	60.0	.0	391	.360
13	I-P.DEGRADATION INDEX-UW	8.5	12.3	.6	.0	60.0	.0	391	.280
14	I-NERVOUSNESS INDEX-UW	20.7	18.9	1.0	.0	83.3	17.6	391	.170
15	I-TURBULENCE INDEX-UW	20.3	15.7	.8	.0	80.0	20.0	391	.100
16	I-AIRSICKNESS INDEX-W	5.5	7.8	.4	.0	50.0	2.0	391	.210
17	I-VOMITING INDEX-W	3.9	7.8	.4	.0	46.7	.0	391	.310
18	I-P.DEGRADATION INDEX-W	3.0	6.1	.3	.0	43.3	.0	391	.280
19	I-NERVOUSNESS INDEX-W	8.1	7.9	.4	.0	41.7	6.7	391	.180
20	I-TURBULENCE INDEX-W	10.1	8.1	.4	.0	53.3	9.8	391	.090
23	TMS01-MS HISTORY,PART 1	9.3	11.3	.6	.0	54.0	5.6	375	.160
24	TMS02-MS HISTORY,PART 2	6.9	9.7	.5	.0	60.0	4.5	375	.200
25	TMS03-MS HISTORY,SUM	16.2	10.9	1.0	.0	100.0	10.3	375	.100
26	TSANX-STATE/ANX.QUEST.	32.2	10.6	1.0	20.0	67.0	30.0	105	.170
27	TTANX-TRAIT/ANX.QUEST.	29.5	6.4	.6	20.0	50.0	29.0	104	.10
28	TSVDT-SVDT TIME OF DAY	9.9	1.7	.1	7.7	15.6	9.6	370	.120
29	TSVDR-SVDT RATER	14.0	6.6	.3	6.0	47.3	11.7	375	.200
30	TSVDS-SVDT SELF-RATING	14.5	6.7	.3	5.0	34.0	13.0	374	.110
31	TSVDP-SVDT POST-RATING	6.4	15.9	.8	.0	102.0	.0	382	.340
32	TVVSP1-VVIT STATIC-RIGHT	120.9	8.5	.8	84.0	129.0	123.0	122	.160
33	TVVSP2-VVIT STATIC-WRONG	5.5	5.3	.5	.0	22.0	4.0	122	.180
34	TVVSP3-VVIT STATIC-OMIT	2.6	5.7	.5	.0	39.0	.0	122	.300
35	TVVDP1-VVIT DYNAMIC-RIGHT	66.1	29.4	2.7	3.0	129.0	63.5	122	.08
36	TVVDP2-VVIT DYNAMIC-WRONG	9.3	6.9	.6	.0	36.0	9.0	122	.10
37	TVVDP3-VVIT DYNAMIC-OMIT	53.6	31.2	2.8	.0	123.0	57.0	122	.08
38	TVVIR-VVIT RATER	18.1	8.1	.7	7.5	50.5	16.2	122	.160
39	TVVIS-VVIT SELF-RATING	17.4	6.9	.6	5.0	33.0	16.5	122	.07
40	TVVIP-VVIT POST-RATING	11.3	19.1	1.7	.0	100.0	4.0	121	.200
41	TVVIT-VVIT TIME OF DAY	10.6	2.1	.2	7.3	15.7	10.3	122	.110

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
0 = SIGNIFICANT BEYOND THE .1 LEVEL
6 = SIGNIFICANT BEYOND THE .01 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

distribution of the observed data was compared to an equivalent theoretical Gaussian distribution with the same mean and standard deviation as the observed data. A total of 49 histogram bins were used to construct the two distributions equally spaced about the mean and extending to four standard deviations to either side of the mean. The maximum absolute deviation of the two distributions was then determined, as listed in Table III. These data indicate that a null hypothesis based upon the assumption that the distribution of the observed data is the same as a normal distribution must be rejected at the .01 significance level or greater for all 20 of the indices. Plots of the normalized cumulative frequency distributions of the observed unweighted and weighted indices along with equivalent theoretical Gaussian distributions are presented in Figures C1 through C5 of Appendix C for both the student- and instructor-derived data.

Table III also contains a corresponding statistical tabulation of the test scores from several reactivity tests that were administered to a large segment of this particular student population. These data are presented at this time for the primary purpose of establishing both group and individual baseline references that can be related on a longitudinal basis to student performance during the advanced and fleet readiness phases of the NFO training program. It is expected that some combination of the laboratory tests will evolve from the longitudinal study that will improve the identification of the relative motion sickness susceptibility of the student NFO population.

A short description of each test score item listed in Table III is presented in Appendix B, along with references that describe the test techniques and procedures in full detail. In brief, TMSQ1, TMSQ2, and TMSQ3 (variable numbers 23, 24, and 25, respectively) pertain to a motion sickness history; TSANX and TTANX (variables 26 and 27) to a state/trait anxiety questionnaire; TBVDT, TBVDR, TBVDS, and TBVDP (variables 28 through 31) to a Brief Vestibular Disorientation Test (BVDT); TVVSP1, TVVSP2, and TVVSP3 (variables 32 through 34) to the static performance element of a Visual-Vestibular Interaction Test (VVIT); TVVDP1, TVVDP2, and TVVDP3 (variables 35 through 37) to the dynamic performance element of the VVIT; and TVVIR, TVVIS, TVVIP, and TVVIT (variables 38 through 41) to the motion sickness rating element of the VVIT.

Plots of the normalized cumulative frequency distribution of the individual scores recorded for these tests, along with a theoretical Gaussian distribution having the same mean and standard deviation as the observed test scores, are presented in Figures C6 through C11 in Appendix C. The Kolmogorov-Smirnov one-sample deviation statistics listed in Table III indicate non-Gaussian distributions for all test scores except those associated with the trait/anxiety questionnaire (variable 27), the three dynamic performance VVIT scores (variables 35-37), and the VVIT self-rating score (variable 39).

COMPARISON OF STUDENT SUBPOPULATIONS BASED UPON ADVANCED TRAINING ASSIGNMENT

Upon completion of basic training in VT-10, the graduated students follow one of four different advanced training pipelines to the fleet; i.e., MAFB, VT-86-AJN, VT-86-RIO, or ATDS. The actual pipelines followed are determined to some degree by student choice, but graded performance and "needs of the service" are considerations which sometimes force a student into a pipeline not of his choosing.

A comparison of the airsickness indices measured for these four different student groups during their VT-10 training must take into account the two different pipelines within the squadron proper. That is, the MAFB group flies only five hops (FM1 through FM5) before graduating, while the three remaining groups fly the same five hops plus thirteen additional hops. Since two of the five familiarization hops involve relatively high motion stress (FM1 and FM5), while only three (FO1, FO2, and FO3) of the remaining hops present equivalent or greater stress (Table I), it would be expected that the response indices for the MAFB group would be greater than those of the three other groups if all hops flown by a given student were used to calculate these indices.

To allow a better comparison, a separate set of response indices based upon only the questionnaire data derived from the five familiarization hops was calculated for each of the four different student groups. Because of the non-Gaussian nature of both the 20-response index measures and the majority of the laboratory test scores, a nonparametric statistical approach was utilized to determine if the students within the MAFB, VT-86-AJN, VT-86-RIO, and ATDS classifications came from the same population. A Kruskal-Wallis one-way analysis of variance by ranks test (10) was applied to the data, with the principal results presented in Table IV. For each inflight response index and for each laboratory test score, a tabulation is made of the Kruskal-Wallis H statistic corrected for tie scores; the total number of students included in the analysis; and, for each of the four student groups, the mean, standard deviation of the observations, the standard error of the mean, and the number of students included in the group. To disprove the null hypothesis that the four student groups came from the same or an identical population requires that the H statistic equal or exceed 11.34 at the .01 significance level and 16.27 at the .001 significance level, assuming that H is distributed like chi squared with three degrees of freedom. (In Table IV, and in all following tables, a probability of .01 was selected as the minimum acceptable degree of statistical significance, thus strengthening the positive identification of real differences at the expense of overlooking real differences that may exist at less significant levels.) Of the twenty questionnaire-response indices, the null hypothesis was disproved only for variable 14, the instructor-based unweighted nervousness index. For this index the mean incidence of nervousness was lowest in the VT-86-RIO student population. The test also shows that there were no differences in the four student populations relative to the 19 laboratory test scores (variables 23 through 41) included in the present study.

Since one element of the longitudinal study involves the later follow-up of the VT-10 students assigned to both the AJN and RIO components of Advanced Training Squadron VT-86, a similar statistical comparison is provided in Table V for these two student groups. The ATDS group is not included because of the relatively low number of students receiving this assignment. In contradistinction to Table IV, the airsickness index data in Table V were calculated on the basis of the entire 18 hops comprising the complete VT-10 flight syllabus. For these data the Kruskal-Wallis H statistic based

Table IV

Results of a Kruskal-Wallis one-way analysis of variance comparison of the flight and laboratory data derived from the four different student subgroups assigned to the MAFB, VT86-AJN, VT86-RIO, and ATDS Advanced training squadrons. The listing includes the Kruskal-Wallis H-statistic corrected for tied ranks, and, for each of the subgroups, the mean, standard deviation, standard error of the mean, and number of students. The flight indices for the individual students were calculated on the basis of only the first five familiarization hops (FM1 through FM5) since the students assigned to MAFB did not fly any of the additional 13 hops comprising the full VT-10 flight syllabus.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	MAFB MEAN	MAFB S.DEV.	MAFB S.ERR.	MAFB N	VT86-AJN MEAN	VT86-AJN S.DEV.	VT86-AJN S.ERR.	VT86-AJN N	VT86-RIO MEAN	VT86-RIO S.DEV.	VT86-RIO S.ERR.	VT86-RIO N	ATDS MEAN	ATDS S.DEV.	ATDS S.ERR.	ATDS N
1	S-AIRSICKNESS INDEX-UW	4.28	24.7	22.6	2.1	122	21.9	20.6	1.8	130	17.2	16.2	1.8	83	19.0	25.5	5.6	21
2	S-VOMITING INDEX-UW	6.02	10.0	15.8	1.4	122	9.3	14.5	1.3	130	6.2	11.7	1.3	83	3.7	7.7	1.7	21
3	S-P.DEGRADATION INDEX-UW	8.94	17.3	20.9	1.9	122	12.4	16.6	1.4	130	8.8	12.5	1.4	83	13.7	24.2	5.3	21
4	S-NERVOUSNESS INDEX-UW	6.33	36.0	38.4	3.2	122	34.0	34.4	3.0	130	44.4	36.7	4.0	83	32.6	36.7	8.0	21
5	S-MEDICATION INDEX-UW	4.18	8.9	20.8	1.8	122	2.5	11.9	1.0	130	2.2	9.7	1.1	83	.0	.0	.0	21
6	S-AIRSICKNESS INDEX-W	3.42	12.8	13.8	1.3	122	9.9	10.2	.9	130	7.7	8.2	.9	83	9.7	12.7	2.8	21
7	S-VOMITING INDEX-W	6.91	5.7	9.1	.8	122	4.5	7.7	.7	130	3.0	5.9	.6	83	1.0	4.0	.9	21
8	S-P.DEGRADATION INDEX-W	8.45	8.6	11.6	1.0	122	6.3	8.8	.8	130	4.1	6.7	.7	83	6.4	10.6	2.3	21
9	S-NERVOUSNESS INDEX-W	6.78	23.4	18.0	1.6	122	22.7	17.0	1.5	130	19.5	18.3	2.0	83	23.0	19.5	4.3	21
10	S-MEDICATION INDEX-W	4.18	3.9	20.8	1.8	122	2.9	11.9	1.0	130	2.3	9.7	1.1	83	.0	.0	.0	21
11	I-AIRSICKNESS INDEX-UW	4.99	17.8	18.3	1.7	122	12.3	16.2	1.4	130	11.9	14.4	1.6	81	10.8	12.0	2.5	21
12	I-VOMITING INDEX-UW	4.83	10.8	15.4	1.4	122	8.8	13.9	1.2	130	6.4	12.1	1.3	81	4.4	8.2	1.8	21
13	I-P.DEGRADATION INDEX-UW	4.01	11.0	15.5	1.4	122	10.1	16.8	1.5	130	8.2	12.1	1.3	81	5.6	9.0	2.0	21
14	I-NERVOUSNESS INDEX-UW	11.730	25.3	22.7	2.1	122	27.4	26.1	2.3	130	19.7	23.7	2.6	81	23.7	23.8	5.2	21
15	I-TURBULENCE INDEX-UW	1.70	20.1	21.1	1.9	122	18.3	17.7	1.6	130	16.5	20.2	2.2	81	13.8	18.1	4.0	21
16	I-AIRSICKNESS INDEX-W	5.70	7.9	9.7	.9	122	5.7	8.1	.7	130	3.3	6.0	.8	81	4.0	5.6	1.2	21
17	I-VOMITING INDEX-W	3.67	5.5	9.2	.8	122	4.0	7.1	.6	130	3.3	6.6	.7	81	2.4	4.7	1.0	21
18	I-P.DEGRADATION INDEX-W	3.08	5.2	7.7	.7	122	4.3	7.6	.7	130	3.3	5.3	.6	81	2.1	3.8	.8	21
19	I-NERVOUSNESS INDEX-W	10.44	11.6	9.6	.9	122	10.2	10.5	.9	130	6.0	10.2	1.1	81	9.7	10.9	2.6	21
20	I-TURBULENCE INDEX-W	1.72	8.7	10.3	.9	122	8.6	8.9	.8	130	7.3	9.1	1.0	81	9.2	9.9	2.1	21
23	TRAIN-MS HISTORY.PART 1	2.22	10.9	12.1	1.2	123	8.9	10.9	1.0	122	8.8	10.3	1.2	76	5.9	6.5	1.5	20
24	TRAIN-MS HISTORY.PART 2	3.01	8.3	11.1	1.0	123	6.4	9.4	.8	122	5.5	7.6	.9	78	4.3	6.0	1.3	20
25	TRAIN-MS HISTORY.SUM	2.46	19.2	22.5	2.0	123	15.0	17.8	1.5	122	14.3	15.6	1.8	78	10.3	11.1	2.5	20
26	TRAIN-STATE/ANX.QUEST.	.97	33.4	10.9	1.6	47	32.1	13.5	2.6	21	31.5	11.4	2.3	25	29.7	2.9	1.4	4
27	TRAIN-TRAIT/ANX.QUEST.	9.34	31.5	6.6	1.0	47	27.0	5.1	1.1	21	27.3	6.2	1.3	24	30.7	6.5	4.2	4
28	TDVDT-DVDT TIME OF DAY	1.30	9.0	1.5	.1	121	10.0	1.5	.2	130	9.7	1.7	.2	78	10.2	1.0	.4	20
29	TDVDR-DVDT RATER	5.22	14.8	6.7	.6	123	13.0	6.5	.6	123	12.2	6.5	.7	78	14.3	7.3	1.6	20
30	TDVDS-DVDT SELF-RATING	5.90	15.2	7.0	.6	122	15.1	6.9	.6	130	13.0	6.1	.7	78	14.6	7.0	1.6	20
31	TDVDP-DVDT PEER-RATING	5.03	7.2	17.2	1.6	116	6.1	13.6	1.2	126	6.1	19.3	2.3	72	7.4	14.0	2.2	19
32	TVVDP1-VVIT STATIC-RIGHT	1.08	120.1	10.8	1.4	32	121.3	7.0	1.3	30	122.5	6.7	1.3	30	118.6	12.5	5.8	5
33	TVVDP2-VVIT STATIC-WRONG	1.79	5.5	5.8	.7	32	5.9	5.8	1.1	30	4.4	4.9	.9	30	6.0	9.3	4.1	5
34	TVVDP3-VVIT STATIC-OMIT	.07	3.4	8.0	1.1	32	1.0	2.5	.5	30	2.0	3.1	.6	30	2.4	3.9	1.7	5
35	TVVDP1-VVIT DYNAMIC-RIGHT	.69	63.2	31.0	4.3	32	67.7	29.9	5.6	30	64.6	29.7	5.6	28	62.0	26.6	12.0	5
36	TVVDP2-VVIT DYNAMIC-WRONG	4.13	8.6	6.9	1.0	32	10.0	5.8	1.1	30	8.6	7.1	1.4	28	7.4	6.9	3.1	5
37	TVVDP3-VVIT DYNAMIC-OMIT	.02	35.2	33.3	4.6	32	30.5	21.2	3.9	30	35.7	29.7	5.6	28	30.6	29.7	13.3	5
38	TVVIR-VVIT RATER	3.98	19.5	8.8	1.2	32	15.9	7.3	1.4	28	18.1	8.0	1.5	28	15.7	4.4	2.0	5
39	TVVIS-VVIT SELF-RATING	1.12	17.9	7.3	1.0	32	17.2	7.3	1.4	23	16.5	5.8	1.1	28	19.2	7.0	2.5	5
40	TVVIP-VVIT PEER-RATING	2.97	12.4	21.3	2.0	32	7.6	11.1	2.1	28	11.4	21.8	4.1	28	16.8	25.2	11.3	5
41	TVVIT-VVIT TIME OF DAY	.09	10.6	2.2	.3	32	10.7	2.2	.4	28	10.2	1.8	.3	28	10.0	1.2	.5	5

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL
UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

Table V

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who graduated from Squadron VT-10 and were assigned to Advanced Training Squadron VT86-AJN with students who graduated and were assigned to Squadron VT86-RIO. In contradistinction to Table IV, the flight indices for this table and all following tables were calculated on the basis of all flights flown by each individual student.

NO.	RESPONSE VARIABLE DESCRIPTION	H STATISTIC	VT86-AJN MEAN	VT86-AJN S.DEV.	VT86-AJN S.ERR.	VT86-AJN N	VT86-RIO MEAN	VT86-RIO S.DEV.	VT86-RIO S.ERR.	VT86-RIO N
1	S-AIRSICKNESS INDEX-UW	3.47	15.6	13.0	1.2	144	12.5	13.1	1.4	88
2	S-VOMITING INDEX-UW	2.83	7.0	10.6	.9	144	5.1	9.4	1.0	88
3	S-P.DEGRADATION INDEX-UW	2.42	9.0	11.7	1.0	144	7.5	10.1	1.1	88
4	S-NERVOUSNESS INDEX-UW	4.99	34.1	26.5	2.2	144	27.2	26.1	2.8	88
5	S-MEDICATION INDEX-UW	.12	2.2	7.9	.7	144	2.5	8.1	.9	88
6	S-AIRSICKNESS INDEX-W	3.20	7.7	8.4	.7	144	5.9	6.0	.7	88
7	S-VOMITING INDEX-W	2.45	3.7	6.2	.5	144	2.6	5.4	.6	88
8	S-P.DEGRADATION INDEX-W	2.56	5.0	7.0	.6	144	3.6	5.1	.5	88
9	S-NERVOUSNESS INDEX-W	5.24	14.0	11.3	.9	144	11.2	11.5	1.2	88
10	S-MEDICATION INDEX-W	.12	2.2	7.9	.7	144	2.5	8.1	.9	88
11	I-AIRSICKNESS INDEX-UW	.14	9.4	11.4	1.0	144	8.5	10.5	1.1	88
12	I-VOMITING INDEX-UW	2.00	6.7	10.3	.9	144	4.9	9.0	1.0	88
13	I-P.DEGRADATION INDEX-UW	.01	7.3	10.5	.9	144	6.1	8.2	.9	88
14	I-NERVOUSNESS INDEX-UW	9.30@	17.3	14.2	1.2	144	11.9	12.6	1.3	88
15	I-TURBULENCE INDEX-UW	1.07	21.2	12.0	1.1	144	19.2	12.5	1.3	88
16	I-AIRSICKNESS INDEX-W	.15	4.4	6.4	.5	144	3.0	5.2	.6	88
17	I-VOMITING INDEX-W	1.95	3.2	5.3	.4	144	2.4	4.7	.5	88
18	I-P.DEGRADATION INDEX-W	.01	3.1	5.1	.4	144	2.8	3.9	.4	88
19	I-NERVOUSNESS INDEX-W	7.63@	6.5	5.5	.5	144	4.7	5.3	.6	88
20	I-TURBULENCE INDEX-W	.32	11.0	6.9	.6	144	10.2	6.5	.7	88
21	SQUADRON ACADEMIC GRADES	17.64*	50.9	4.7	.4	144	53.7	4.9	.5	88
22	SQUADRON FLIGHT GRADES	29.29*	3.0	.5	.0	144	3.0	.0	.0	88
23	TNS01-MS HISTORY,PART 1	.40	8.5	10.9	1.0	132	8.0	10.3	1.2	70
24	TNS02-MS HISTORY,PART 2	.30	6.4	9.4	.8	132	5.5	7.6	.9	70
25	TNS03-MS HISTORY,SUM	.02	15.0	17.0	1.5	132	14.3	15.6	1.8	70
26	TSANX-STATE/ANX.QUEST.	.02	32.1	10.9	2.4	21	31.5	11.4	2.3	25
27	TTANX-TRAIT/ANX.QUEST.	.20	27.0	5.1	1.1	21	27.3	6.2	1.3	24
28	TSVDT-SVDT TIME OF DAY	.01	10.0	1.9	.2	130	9.7	1.7	.2	70
29	TSVDR-SVDT RATER	.01	13.0	6.5	.6	133	13.3	6.5	.7	70
30	TSVDS-SVDT SELF-RATING	4.47	15.1	6.9	.6	133	13.0	6.1	.7	70
31	TSVDP-SVDT POST-RATING	.00	6.1	13.6	1.2	126	6.1	15.3	2.3	72
32	TVVSP1-VVIT STATIC-RIGHT	.62	121.3	7.0	1.3	20	122.5	6.7	1.3	20
33	TVVSP2-VVIT STATIC-WRONG	.70	5.9	5.0	1.1	20	4.4	4.9	.9	20
34	TVVSP3-VVIT STATIC-OMIT	.00	1.9	2.0	.5	20	2.0	3.1	.6	20
35	TVVDP1-VVIT DYNAMIC-RIGHT	.33	67.7	29.9	5.6	20	64.6	29.7	5.6	20
36	TVVDP2-VVIT DYNAMIC-WRONG	2.06	10.0	5.0	1.1	20	8.6	7.1	1.4	20
37	TVVDP3-VVIT DYNAMIC-OMIT	.57	50.5	31.2	5.9	20	55.7	29.7	5.6	20
38	TVVIR-VVIT RATER	.00	15.9	7.3	1.4	20	16.1	8.0	1.5	20
39	TVVIS-VVIT SELF-RATING	.00	17.2	7.3	1.4	20	16.5	5.0	1.1	20
40	TVVIP-VVIT POST-RATING	.14	7.6	11.1	2.1	20	11.4	21.0	4.1	20
41	TVVIT-VVIT TIME OF DAY	.07	10.7	2.2	.4	20	10.2	1.0	.3	20

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
@ = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

upon one degree of freedom is required to equal or exceed 6.64 at the .01 significance level or 10.83 at the .001 level to disprove the null hypothesis that the VT-86-AJN and VT-86-RIO students came from the same or an identical population. Again, there are no significant differences among the populations for any of the response indices, with the exception of the unweighted and weighted instructor measures of student nervousness (variables 14 and 19). The means of these two indices were lowest for the VT-86-RIO population. Table V also shows a significant difference for the over-all academic and flight grades (variables 21 and 22) of the two groups. (These data are included in this particular table since the grading format for these two populations was identical.) As denoted by the mean grade data, the students assigned to VT-86-RIO had the better academic and flight grade performance. Again, there were no significant differences at the .01 level or greater for any of the laboratory test scores.

A third comparison involves those students who graduated from the squadron and those who attrited for any reason whatsoever. The results of applying the same Kruskal-Wallis one-way analysis of variance to these student groups are summarized in Table VI. The airsickness indices in this case were calculated on the basis of all flights flown by the students. The effectiveness of the Kruskal-Wallis test in this particular comparison is restricted by the relatively low number of attrited students (N = 25) present at this phase of the study. Once again, the only significant difference identified in the two populations involves the unweighted and weighted nervousness indices that were greater for the attrite group. The analysis showed no significant difference in the laboratory test scores for the two groups.

COMPARISON OF STUDENT SUBPOPULATIONS BASED UPON AIRSICKNESS SENSITIVITY

In the previous comparisons, emphasis has been placed on identifying differences among population classifications based upon the graduation and advanced training assignments of the students. In effect, the classifications have been independent of the data produced by the airsickness questionnaire. Since one of the long-term objectives of this laboratory is to develop and validate an airsickness test battery to identify both susceptible and nonsusceptible aviation candidates, it is also of value to investigate response variable differences that may exist between students with high index scores (susceptible) and students with low index scores (nonsusceptible) even at this early phase of the longitudinal study.

To facilitate the comparison of the response variables derived from airsick and nonairsick students, the following classifications were arbitrarily defined, using the weighted airsickness index data derived from the student questionnaire (variable 6). The nonairsick population included only those students who were never airsick and thus had a weighted airsickness index of 0.0. The airsick population included only those students who had a weighted airsickness index that equaled or exceeded the 90th-centile reference established by the normalized cumulative frequency distribution for this particular index. The distribution data presented in Figure C1-B indicate that at the 90th-centile point, the weighted airsickness index score was approximately 24.0. Thus, all

Table VI

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who graduated from Squadron VT-10 with students who attrited from the squadron after beginning flight training.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	GRADUATED MEAN	S.DEV.	S.ERR.	N	ATTRITED MEAN	S.DEV.	S.ERR.	N
1	S-AIRSICKNESS INDEX-UW	4.87	17.7	17.0	.9	376	26.1	18.1	4.7	18
2	S-VOMITING INDEX-UW	1.13	7.7	12.4	.6	376	10.7	14.0	3.6	18
3	S-P.DEGRADATION INDEX-UW	6.39	11.0	15.7	.8	376	20.2	17.7	4.6	18
4	S-NERVOUSNESS INDEX-UW	2.67	39.4	31.6	1.6	376	57.3	41.2	10.6	18
5	S-MEDICATION INDEX-UW	.20	3.4	13.2	.7	376	5.2	20.1	5.2	18
6	S-AIRSICKNESS INDEX-W	3.70	8.9	10.4	.5	376	12.0	11.1	2.9	18
7	S-VOMITING INDEX-W	1.38	4.1	7.2	.4	376	5.9	8.8	2.1	18
8	S-P.DEGRADATION INDEX-W	3.02	5.0	8.7	.4	376	8.7	9.3	2.4	18
9	S-NERVOUSNESS INDEX-W	1.54	16.0	15.0	.8	376	25.9	24.7	6.4	18
10	S-MEDICATION INDEX-W	.20	3.4	13.2	.7	376	5.2	20.1	5.2	18
11	I-AIRSICKNESS INDEX-UW	.00	11.6	14.2	.7	376	17.0	21.0	5.4	18
12	I-VOMITING INDEX-UW	1.01	7.3	11.9	.6	376	12.7	17.9	4.6	18
13	I-P.DEGRADATION INDEX-UW	1.43	8.3	11.8	.6	376	15.0	20.5	5.3	18
14	I-NERVOUSNESS INDEX-UW	7.33@	20.0	18.0	.9	376	39.7	30.5	7.4	18
15	I-TURBULENCE INDEX-UW	.92	20.4	15.7	.8	376	17.0	14.4	3.7	18
16	I-AIRSICKNESS INDEX-W	1.01	5.4	7.5	.4	376	9.4	12.9	3.3	18
17	I-VOMITING INDEX-W	1.10	3.0	6.7	.3	376	7.3	11.4	2.9	18
18	I-P.DEGRADATION INDEX-W	1.61	2.6	5.8	.3	376	7.9	11.3	2.9	18
19	I-NERVOUSNESS INDEX-W	6.14@	7.0	7.5	.4	376	16.1	12.6	3.2	18
20	I-TURBULENCE INDEX-W	.44	10.2	8.1	.4	376	6.0	7.2	1.9	18
23	TH001-MS HISTORY,PART 1	.41	9.3	11.5	.6	383	9.1	8.3	1.8	22
24	TH002-MS HISTORY,PART 2	.93	6.0	9.6	.5	383	8.9	10.9	2.3	22
25	TH003-MS HISTORY,SUM	.63	16.0	19.0	1.0	382	18.0	18.1	3.9	22
26	TSANX-STATE/ANX.QUEST.	1.07	32.5	10.7	1.1	97	25.9	8.7	3.1	9
27	TTANX-TRAIT/ANX.QUEST.	.72	29.7	6.5	.7	96	27.4	4.7	1.7	9
28	TDTDT-DVDT TIME OF DAY	1.55	9.9	1.7	.1	349	10.3	1.7	.4	21
29	TDVDR-DVDT RATER	.51	14.1	6.6	.4	384	12.9	5.1	1.1	21
30	TDVDS-DVDT SELF-RATING	2.33	14.6	6.0	.4	383	12.1	5.2	1.1	21
31	TDVDP-DVDT POST-RATING	.02	6.6	16.2	.9	333	4.2	10.2	2.3	19
32	TVVSP1-VVIT STATIC-RIGHT	.64	128.9	8.7	.8	113	128.2	6.0	2.0	9
33	TVVSP2-VVIT STATIC-WRONG	.73	5.4	5.4	.5	113	6.3	4.6	1.5	9
34	TVVSP3-VVIT STATIC-OMIT	.10	2.6	5.8	.5	113	2.4	3.5	1.2	9
35	TVVDP1-VVIT DYNAMIC-RIGHT	.95	65.6	29.9	2.8	113	72.3	21.7	7.2	9
36	TVVDP2-VVIT DYNAMIC-WRONG	1.20	9.1	6.7	.6	113	12.6	9.2	3.1	9
37	TVVDP3-VVIT DYNAMIC-OMIT	.02	54.4	31.4	3.0	113	44.1	27.7	9.2	9
38	TVVIR-VVIT RATER	.00	10.1	8.2	.8	113	17.0	6.5	2.3	9
39	TVVIS-VVIT SELF-RATING	.05	17.4	6.9	.7	113	17.4	6.5	2.2	9
40	TVVIP-VVIT POST-RATING	.49	11.6	10.5	1.0	113	8.0	11.9	4.2	9
41	TVVIT-VVIT TIME OF DAY	1.11	10.5	2.1	.2	113	11.5	2.5	.8	9

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
@ = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

students with an index score equal to or greater than this level were defined as the airsick population for this squadron. These distribution data also indicate that the nonairsick group included approximately 26 percent of the total squadron population. (The weighted airsickness index for each student was calculated on the basis of all hops flown.)

These two criteria were used to define the susceptible and nonsusceptible populations, and a Kruskal-Wallis one-way analysis of variance was performed on each of the response variables, the results of which are tabulated in Table VII. With one degree of freedom the H statistic must equal or exceed 6.64 to establish at the .01 significance level that the airsick and nonairsick students are not from the same population, and equal or exceed 10.83 at the .001 significance level. As indicated in Table VII, all twenty of the questionnaire indices are significantly different for the two populations. This would be expected for the unweighted and weighted airsickness, vomiting, performance degradation, and medication indices since these items are all airsickness-related, and the airsickness index proper served to establish the two populations being compared. As indicated by variables 4, 9, 14, and 19, the student nervousness index also derived from two different populations. The same applies to the instructor rating of turbulence. For all twenty of the questionnaire indices, the mean for the airsick group was greater than the mean for the nonairsick group.

For most of the laboratory tests (variables 23 through 41) the differences between populations were not so pronounced as for the questionnaire indices. However, all three items of the motion sickness questionnaire, the state anxiety questionnaire, and the BVDT rater, self-rating, and post-self-rating scores, had significant H statistics. No significant differences were found for the trait anxiety questionnaire or any of the VVIT scores.

Table VIII provides a similar comparison between students with a high (upper decile) weighted vomit index and students who never vomited on their training flights. This latter group, representing approximately 61 percent of the total student population, includes the Table VII students who were never airsick and thus never vomited, as well as those students who experienced airsickness but never vomited. The upper decile for the susceptible group was marked by a weighted vomit index score of 14.4, as derived from the Figure C2-B distribution data. Again, all twenty index scores for the susceptible group were greater than the related scores for the nonsusceptible group. The laboratory test scores also generally followed the Table VII pattern, with significant differences present in the three motion sickness questionnaire scores, the state anxiety questionnaire, and the three BVDT rating scores. In addition, the VVIT self-rating and post-self-rating scores (variables 39 and 40) showed significant differences in the two populations.

The same comparative analysis was performed, utilizing the weighted performance degradation index to define susceptible and nonsusceptible populations. A weighted performance degradation index score of 16.0 or greater marked the upper decile susceptible group as derived from the Figure C3-B distribution data. The nonsusceptible group included approximately 42 percent of the total population. The results of the Kruskal-Wallis one-way analysis of variance for these populations are summarized in Table IX.

Table VII

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never experienced airsickness during flight training with students who had a relatively high incidence of airsickness. The non-airsick group, defined as those students with a weighted airsickness index (variable 6 from the student questionnaire data) equal to 0.0, represented approximately 26 percent of the total study population. The airsick group, arbitrarily established as the most sensitive 10 percent of the students, was defined as those individuals with a weighted airsickness index equal to or greater than 24.0 which marked the upper decile for this measure.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	NON-AIRSICK MEAN	NON-AIRSICK S.DEV.	NON-AIRSICK S.ERR.	NON-AIRSICK N	AIRSICK MEAN	AIRSICK S.DEV.	AIRSICK S.ERR.	AIRSICK N
1	S-AIRSICKNESS INDEX-UW	133.00*	.0	.0	.0	102	57.1	15.0	2.6	36
2	S-VOMITING INDEX-UW	119.18*	.0	.0	.0	102	30.7	14.9	2.5	36
3	S-P.DEGRADATION INDEX-UW	117.55*	.7	3.0	.3	102	46.4	20.1	3.3	36
4	S-NERVOUSNESS INDEX-UW	49.24*	23.6	27.9	2.9	102	75.4	23.4	3.9	36
5	S-MEDICATION INDEX-UW	39.46*	.2	2.0	.2	102	20.3	32.1	5.4	36
6	S-AIRSICKNESS INDEX-W	133.02*	.0	.0	.0	102	34.2	9.6	1.6	36
7	S-VOMITING INDEX-W	119.04*	.0	.0	.0	102	10.4	9.7	1.6	36
8	S-P.DEGRADATION INDEX-W	117.53*	.3	1.1	.1	102	25.7	11.9	2.0	36
9	S-NERVOUSNESS INDEX-W	40.66*	11.1	11.9	1.2	102	33.9	14.2	2.4	36
10	S-MEDICATION INDEX-W	39.46*	.2	2.0	.2	102	20.3	32.1	5.4	36
11	I-AIRSICKNESS INDEX-UW	100.69*	.4	2.3	.2	101	37.6	17.4	2.9	35
12	I-VOMITING INDEX-UW	112.50*	.0	.0	.0	101	29.7	15.6	2.6	35
13	I-P.DEGRADATION INDEX-UW	96.39*	.9	3.0	.4	101	29.4	15.7	2.7	35
14	I-NERVOUSNESS INDEX-UW	36.03*	15.0	16.2	1.6	101	41.9	21.0	3.5	35
15	I-TURBULENCE INDEX-UW	17.45*	16.1	14.9	1.5	101	32.1	20.4	3.4	35
16	I-AIRSICKNESS INDEX-W	100.09*	.1	.0	.1	101	20.6	11.2	1.9	35
17	I-VOMITING INDEX-W	112.56*	.0	.0	.0	101	10.2	10.4	1.0	35
18	I-P.DEGRADATION INDEX-W	96.97*	.3	1.3	.1	101	14.7	9.5	1.6	35
19	I-NERVOUSNESS INDEX-W	20.06*	6.2	7.1	.7	101	15.7	8.7	1.5	35
20	I-TURBULENCE INDEX-W	10.60$	8.1	7.9	.8	101	14.6	10.0	1.8	35
23	THS01-MS HISTORY,PART 1	40.62*	4.3	8.4	.9	94	21.4	15.0	2.5	35
24	THS02-MS HISTORY,PART 2	51.74*	2.0	5.2	.5	94	16.5	13.5	2.3	35
25	THS03-MS HISTORY,SUM	54.08*	7.1	11.5	1.2	94	37.9	25.9	4.4	35
26	TSANX-STATE/ANX.QUEST.	14.36*	27.0	7.4	1.6	21	41.0	11.0	3.1	13
27	TTANX-TRAIT/ANX.QUEST.	2.22	20.0	6.9	1.5	21	31.9	5.4	1.5	13
28	TSVDT-SVDT TIME OF DAY	4.15	10.0	1.7	.2	93	9.6	2.0	.3	34
29	TSVDR-SVDT RATER	24.81*	11.6	4.4	.5	94	19.1	8.9	1.5	35
30	TSVDS-SVDT SELF-RATING	39.66*	10.7	5.1	.5	94	20.6	7.0	1.2	35
31	TSVDP-SVDT POST-RATING	27.25*	1.3	3.1	.3	89	17.4	27.5	4.6	35
32	TVVSP1-VVIT STATIC-RIGHT	2.55	116.6	12.4	2.5	25	123.2	4.3	1.1	16
33	TVVSP2-VVIT STATIC-WRONG	1.44	7.4	6.2	1.2	25	4.6	4.0	1.0	16
34	TVVSP3-VVIT STATIC-OMIT	1.99	5.0	10.6	2.1	25	1.1	1.9	.5	16
35	TVVDP1-VVIT DYNAMIC-RIGHT	.46	62.8	24.2	4.0	25	56.6	35.7	8.9	16
36	TVVDP2-VVIT DYNAMIC-WRONG	1.46	10.6	7.9	1.6	25	8.3	7.3	1.8	16
37	TVVDP3-VVIT DYNAMIC-OMIT	.56	56.4	25.8	5.2	25	64.1	40.0	10.0	16
38	TVVIR-VVIT RATER	6.39	15.2	5.8	1.2	25	23.1	10.6	2.7	16
39	TVVIS-VVIT SELF-RATING	6.40	14.6	6.2	1.2	25	21.6	9.1	2.3	16
40	TVVIP-VVIT POST-RATING	4.35	5.6	12.2	2.4	25	22.1	30.4	7.6	16
41	TVVIT-VVIT TIME OF DAY	.08	10.4	2.1	.4	25	10.3	2.0	.5	16

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
$ = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

Table VIII

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never reported vomiting during training with students who reported a relatively high incidence of vomiting. The non-vomit group, defined as those students with a weighted vomit index (variable 7 from the student questionnaire data) equal to 0.0 and represented approximately 61 percent of the study population. The vomit group was defined as those students with a weighted vomit index equal to or greater than 14.4 which marked the upper decile for this measure.

RESPONSE VARIABLE NO	DESCRIPTION	H STATISTIC	NON-VOMIT MEAN	NON-VOMIT S. DEV.	NON-VOMIT S. ERR.	NON-VOMIT N	VOMIT MEAN	VOMIT S. DEV.	VOMIT S. ERR.	VOMIT N
1	S-AIRSICKNESS INDEX-UW	92.28*	9.7	11.7	.8	230	46.5	17.9	2.9	39
2	S-VOMITING INDEX-UW	273.93*	.0	.0	.0	230	32.9	11.0	1.8	39
3	S-P DEGRADATION INDEX-UW	103.49*	5.5	10.1	.7	230	37.3	18.1	2.9	39
4	S-NERVOUSNESS INDEX-UW	14.43*	35.9	32.1	2.1	230	56.8	30.9	4.9	39
5	S-MEDICATION INDEX-UW	76.36*	.3	2.1	.1	230	19.9	30.7	4.9	39
6	S-AIRSICKNESS INDEX-W	100.05*	4.0	5.4	.3	230	20.7	10.7	1.7	39
7	S-VOMITING INDEX-W	273.94*	.0	.0	.0	230	21.7	6.4	1.0	39
8	S-P DEGRADATION INDEX-W	109.18*	2.3	4.4	.3	230	21.2	11.1	1.8	39
9	S-NERVOUSNESS INDEX-W	15.09*	15.2	15.3	1.0	230	24.6	15.1	2.4	39
10	S-MEDICATION INDEX-W	76.36*	.3	2.1	.1	230	19.9	30.7	4.9	39
11	I-AIRSICKNESS INDEX-UW	120.53*	4.3	8.8	.5	237	39.5	13.0	2.1	39
12	I-VOMITING INDEX-UW	220.38*	.3	1.9	.1	237	32.1	10.4	1.7	39
13	I-P. DEGRADATION INDEX-UW	129.84*	2.8	6.4	.4	237	30.7	12.0	2.0	39
14	I-NERVOUSNESS INDEX-UW	16.31*	17.9	17.7	1.2	237	32.0	21.9	3.5	39
15	I-TURBULENCE INDEX-UW	29.34*	16.3	14.1	.9	237	32.5	18.8	2.9	39
16	I-AIRSICKNESS INDEX-W	124.23*	1.6	3.2	.2	237	21.9	9.1	1.5	39
17	I-VOMITING INDEX-W	229.29*	.1	.7	.0	237	19.9	7.7	1.2	39
18	I-P DEGRADATION INDEX-W	132.52*	1.0	2.6	.2	237	15.6	8.7	1.4	39
19	I-NERVOUSNESS INDEX-W	14.03*	7.1	7.7	.5	237	12.5	9.1	1.5	39
20	I-TURBULENCE INDEX-W	19.18*	8.4	7.9	.5	237	15.2	9.7	1.6	39
23	TMS01-MS HISTORY PART 1	21.36*	6.1	8.9	.6	221	14.9	12.9	2.1	36
24	TMS02-MS HISTORY PART 2	26.60*	3.9	6.3	.4	221	11.7	13.1	2.2	36
25	TMS03-MS HISTORY SUM	27.81*	10.0	13.4	.9	221	26.7	23.6	3.9	36
26	TSANX-STATE/ANX QUEST	7.03$	29.5	8.8	1.1	61	37.9	10.1	2.8	13
27	TTANX-TRAIT/ANX QUEST	.00	29.3	6.9	.9	61	28.9	5.2	1.5	12
28	TBVDT-BVDT TIME OF DAY	3.40	10.1	1.8	.1	217	9.7	1.3	.3	35
29	TBVDR-BVDT RATER	10.93*	12.4	5.1	.3	221	10.2	8.7	1.4	36
30	TBVDS-BVDT SELF-RATING	38.64*	12.5	5.7	.4	221	20.2	6.5	1.1	36
31	TBVDP-BVDT POST-RATING	16.57*	3.1	9.0	.6	208	13.0	23.9	4.0	35
32	TVVSP1-VVIT STATIC-RIGHT	3.38	119.6	9.8	1.2	60	124.9	3.9	1.0	15
33	TVVSP2-VVIT STATIC-WRONG	2.39	6.1	5.7	.7	60	3.3	3.2	.8	15
34	TVVSP3-VVIT STATIC-OMIT	2.78	3.3	7.1	.9	60	.8	1.8	.5	15
35	TVVDP1-VVIT DYNAMIC-RIGHT	.04	68.4	25.9	3.1	60	65.6	37.0	9.5	15
36	TVVDP2-VVIT DYNAMIC-WRONG	1.42	10.3	7.1	.9	60	8.3	7.6	2.0	15
37	TVVDP3-VVIT DYNAMIC-OMIT	.11	50.3	27.0	3.3	60	58.1	42.0	10.8	15
38	TVVIR-VVIT RATER	4.03	15.5	6.2	.7	60	22.4	11.7	3.0	15
39	TVVIS-VVIT SELF-RATING	7.02$	15.4	5.6	.7	60	21.1	7.7	2.0	15
40	TVVIP-VVIT POST-RATING	7.60$	7.7	13.0	1.7	60	18.6	19.7	5.1	15
41	TVVIT-VVIT TIME OF DAY	.56	10.5	2.0	.2	60	10.9	2.2	.6	15

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
$ = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

Table IX

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never reported experiencing in-flight performance degradation due to airsickness with students who reported a relatively high incidence of performance degradation. The non-affected group, defined as those students with a weighted performance degradation index (variable 8 from the student questionnaire data) equal to 0.0, represented approximately 42 percent of the study population. The affected group was defined as those students with a weighted performance index equal to or greater than 16.0 which defined the upper decile for this measure.

NO.	RESPONSE VARIABLE DESCRIPTION	H STATISTIC	NO PER. DEGRADATION MEAN	S.DEV.	S.ERR.	N	HIGH PER. DEGRADATION MEAN	S.DEV.	S ERR	N
1	S-AIRSICKNESS INDEX-UW	95.240*	4.4	10.4	.8	165	49.8	18.9	3.0	39
2	S-VOMITING INDEX-UW	139.240*	.9	4.6	.4	165	20.9	19.2	2.4	39
3	S-P.DEGRADATION INDEX-UW	200.000*	.0	.0	.0	165	45.9	19.2	3.1	39
4	S-NERVOUSNESS INDEX-UW	49.080*	29.2	29.4	2.3	165	78.0	26.6	4.7	39
5	S-MEDICATION INDEX-UW	52.930*	.2	1.8	.1	165	10.7	31.3	5.0	39
6	S-AIRSICKNESS INDEX-W	103.450*	2.4	4.0	.3	165	30.9	11.6	1.1	39
7	S-VOMITING INDEX-W	142.780*	.3	1.6	.1	165	17.8	9.9	1.4	39
8	S-P.DEGRADATION INDEX-W	208.030*	.0	.0	.0	165	26.5	10.2	1.6	39
9	S-NERVOUSNESS INDEX-W	48.930*	12.1	12.9	1.0	165	32.1	18.2	2.4	39
10	S-MEDICATION INDEX-W	52.930*	.2	1.0	.1	165	10.7	31.3	5.0	39
11	I-AIRSICKNESS INDEX-UW	109.740*	2.7	7.2	.6	164	36.1	16.0	2.6	38
12	I-VOMITING INDEX-UW	130.180*	.7	4.1	.3	164	29.6	15.0	2.4	38
13	I-P.DEGRADATION INDEX-UW	142.780*	1.0	3.6	.3	164	29.3	13.8	2.2	38
14	I-NERVOUSNESS INDEX-UW	30.160*	15.0	15.9	1.2	164	30.2	20.0	3.2	38
15	I-TURBULENCE INDEX-UW	22.320*	15.9	13.9	1.1	164	31.6	18.5	3.0	38
16	I-AIRSICKNESS INDEX-W	114.050*	1.0	2.6	.2	164	19.8	10.4	1.7	38
17	I-VOMITING INDEX-W	140.450*	.3	1.5	.1	164	17.7	10.2	1.7	38
18	I-P.DEGRADATION INDEX-W	145.070*	.3	1.2	.1	164	14.9	8.8	1.4	38
19	I-NERVOUSNESS INDEX-W	32.150*	6.1	7.0	.5	164	14.6	8.5	1.4	38
20	I-TURBULENCE INDEX-W	15.080*	7.9	7.1	.6	164	14.3	9.1	1.5	38
23	THS01-MS HISTORY, PART 1	42.990*	5.1	8.0	.6	154	19.3	14.9	2.5	36
24	THS02-MS HISTORY, PART 2	36.230*	4.1	7.4	.6	154	15.1	14.0	2.3	36
25	THS03-MS HISTORY, SUM	42.200*	9.2	13.4	1.1	154	34.4	27.0	4.5	36
26	TSANX-STATE/ANX.QUEST.	10.540*	29.4	10.0	1.6	40	40.5	11.0	3.3	13
27	TTANX-TRAIT/ANX.QUEST	3.91	20.9	6.5	1.0	40	32.3	4.6	1.3	13
28	TSVDT-SVDT TIME OF DAY	2.12	9.9	1.5	.1	152	9.0	2.0	.3	35
29	TSVDR-SVDT RATER	20.030*	12.0	4.0	.4	154	10.4	5.9	1.5	36
30	TSVDS-SVDT SELF-RATING	34.980*	11.7	5.6	.5	154	19.6	6.0	1.1	36
31	TSVDP-SVDT POST-RATING	19.420*	2.3	6.1	.5	141	15.0	27.2	4.5	36
32	TVVSP1-VVIT STATIC-RIGHT	3.05	119.4	10.4	1.5	46	124.0	3.5	.9	16
33	TVVSP2-VVIT STATIC-WRONG	1.16	5.0	5.5	.8	46	3.4	2.9	.7	16
34	TVVSP3-VVIT STATIC-OMIT	3.54	3.0	8.3	1.2	46	.8	1.7	.4	16
35	TVVDP1-VVIT DYNAMIC-RIGHT	.62	60.6	28.2	4.2	46	60.4	37.0	9.2	16
36	TVVDP2-VVIT DYNAMIC-WRONG	4.23	10.5	7.4	1.1	46	6.9	7.0	1.8	16
37	TVVDP3-VVIT DYNAMIC-OMIT	1.01	49.9	28.6	4.2	46	61.7	40.3	10.1	16
38	TVVIR-VVIT RATER	3.92	15.7	6.5	1.0	46	21.7	11.3	2.8	16
39	TVVIS-VVIT SELF-RATING	14.710*	14.5	6.0	.9	46	23.2	6.7	1.7	16
40	TVVIP-VVIT POST-RATING	6.10	7.3	15.3	2.3	46	22.0	38.3	7.6	16
41	TVVIT-VVIT TIME OF DAY	.06	10.4	2.0	.3	46	11.0	2.1	.5	16

S = STUDENT RESPONSE DATA UW = UNWEIGHTED RESPONSE INDEX
I = INSTRUCTOR RESPONSE DATA W = WEIGHTED RESPONSE INDEX
# = SIGNIFICANT BEYOND THE .01 LEVEL
* = SIGNIFICANT BEYOND THE .001 LEVEL

Again, the same pattern of response differences exists for these data that were described in relation to Table VIII, with the one exception that the differences in the VVIT post-self-rating scores were not statistically significant for the two populations.

Table X presents a corresponding analysis based upon the weighted nervousness index scores calculated from the student questionnaire data. The upper decile used to identify the highly nervous population was marked by a weighted nervousness index score of 40.5 or greater, as derived from the Figure C4-B distribution data. The non-nervous group, i.e., the students who indicated that they never experienced nervousness during flight training, was defined by only 11 percent of the total population. The Table X data indicate that, with the exception of the medication usage index and the turbulence index, the questionnaire responses derived from the two populations differ significantly. However, the differences in the means for the two groups are, in general, smaller than those found with the three previous analyses. In the case of the laboratory test scores, population differences were found only for the BVDT self-rating score and the VVIT post-test self-rating score.

The results of the four student group comparisons described by Tables VII through X indicate that certain elements of the laboratory test battery have the potential, even at this early phase of the longitudinal study, to separately distinguish between susceptible and nonsusceptible populations, using the flight data proper as a criterion. As emphasized earlier, the four weighted indices used to define the susceptible and non-susceptible, i.e., high reactors or low reactors, in these tables were extracted from the student element of the questionnaire. For some of the laboratory tests included in the current analysis, it could be argued that the differences noted in the populations reflect the method or philosophy utilized by individual students to rate or score their inflight airsickness symptoms. For example, with the BVDT self-rating score (variable 30) the student is required to assign a relative degree of severity to different symptoms he experienced during the test. His evaluation of the airsickness symptoms experienced on a given flight also calls for a rating of over-all severity. In this context, it could be argued that one would expect that an individual who highly rated his symptoms during the BVDT would also highly rate his airsickness experiences.

If, however, one utilizes the instructor-derived data to establish high and low reactor groups, the differences in laboratory test scores for the two groups still exist, and as a matter of fact, the statistical confidence improves. This is demonstrated by Table XI which tabulates the results of a Kruskal-Wallis one-way analysis of variance based upon a population subdivision derived from the weighted airsickness index scores provided by the instructors. In this table, the upper decile for the weighted airsickness index is marked by a score of 16.5 or greater, as derived from the Figure C1-D distribution data. The related population defined by the corresponding student-based airsickness index (Table VII) had a higher score of approximately 24.0. The low susceptibility group for the instructor-based population subdivision included approximately 43 percent of the total students, as compared to only 26 percent as defined by the students proper. As indicated by the H statistic in Table XI, all twenty questionnaire indices were derived from different populations. As with the Table VII student-based data, the instructor-based

Table X

Results of a Kruskal-Wallis one-way analysis of variance comparison of students who never reported experiencing nervousness before or during a flight with students who reported a relatively high incidence of nervousness. The non-nervous group, defined as those students with a weighted nervousness index (variable 9 from the student questionnaire data) equal to 0.0, represented approximately 11 percent of the study population. The nervous group was defined as those students with a weighted nervousness index equal to or greater than 40.5 which defined the upper decile for this measure.

RESPONSE VARIABLE NO.	DESCRIPTION	H STATISTIC	NON-NERVOUS MEAN	NON-NERVOUS S.DEV.	NON-NERVOUS S.ERR.	NON-NERVOUS N	NERVOUS MEAN	NERVOUS S.DEV.	NERVOUS S.ERR.	NERVOUS N
1	S-AIRSICKNESS INDEX-UW	29.62•	7.0	9.0	1.5	43	34.3	26.0	4.7	31
2	S-VOMITING INDEX-UW	10.46D	2.0	8.2	1.3	43	13.2	18.6	3.3	31
3	S-P.DEGRADATION INDEX-UW	34.24•	2.3	5.6	.9	43	20.4	27.3	4.9	31
4	S-NERVOUSNESS INDEX-UW	69.27•	.0	.0	.0	43	96.0	8.4	1.5	31
5	S-MEDICATION INDEX-UW	2.01	.0	.0	.0	43	5.2	20.6	3.7	31
6	S-AIRSICKNESS INDEX-W	30.69•	3.0	5.1	.8	43	18.0	16.4	3.0	31
7	S-VOMITING INDEX-W	10.64D	1.6	5.8	.9	43	6.6	9.9	1.8	31
8	S-P.DEGRADATION INDEX-W	34.60•	1.0	2.6	.4	43	15.1	15.0	2.7	31
9	S-NERVOUSNESS INDEX-W	66.39•	.0	.0	.0	43	52.4	10.8	1.9	31
10	S-MEDICATION INDEX-W	2.01	.0	.0	.0	43	5.2	20.6	3.7	31
11	I-AIRSICKNESS INDEX-UW	12.50•	4.6	10.3	1.6	43	16.7	18.0	3.2	31
12	I-VOMITING INDEX-UW	9.60D	2.4	7.7	1.2	43	11.3	14.7	2.6	31
13	I-P.DEGRADATION INDEX-UW	15.40•	2.5	6.2	.9	43	13.6	14.5	2.6	31
14	I-NERVOUSNESS INDEX-UW	38.95•	5.0	6.9	1.0	43	37.5	20.5	3.7	31
15	I-TURBULENCE INDEX-UW	5.42	11.2	12.5	1.9	43	21.1	17.5	3.1	31
16	I-AIRSICKNESS INDEX-W	13.41•	1.0	4.1	.6	43	8.3	9.7	1.7	31
17	I-VOMITING INDEX-W	10.00D	1.0	3.3	.5	43	5.7	8.0	1.4	31
18	I-P.DEGRADATION INDEX-W	16.13•	.0	2.1	.3	43	6.0	7.0	1.3	31
19	I-NERVOUSNESS INDEX-W	30.92•	1.0	2.4	.4	43	15.1	9.8	1.8	31
20	I-TURBULENCE INDEX-W	3.00	6.1	7.1	1.1	43	10.0	9.1	1.6	31
23	TNS01-NS HISTORY PART 1	3.23	3.0	4.9	.8	39	8.2	11.1	2.1	29
24	TNS02-NS HISTORY PART 2	3.93	2.0	4.5	.7	39	8.3	10.7	2.0	29
25	TNS03-NS HISTORY SUM	4.04	6.6	8.0	1.3	39	16.5	[illegible]	3.0	29
26	TSANX-STATE/ANX QUEST	3.19	24.9	4.2	1.2	13	30.4	14.5	4.6	10
27	TTANX-TRAIT/ANX QUEST	3.24	27.2	7.6	2.1	13	31.5	5.0	1.6	10
28	TOVDT-OVDT TIME OF DAY	.20	9.5	1.5	.2	39	10.3	2.2	.4	29
29	TOVDR-OVDT RATER	4.89	12.0	3.0	.5	39	15.3	7.3	1.3	29
30	TOVDS-OVDT SELF-RATING	6.90D	10.2	5.0	.8	39	15.0	7.7	1.4	29
31	TOVDP-OVDT POST-RATING	4.41	3.4	11.2	1.9	35	6.4	12.3	2.3	28
32	TVVSP1-VVIT STATIC-RIGHT	.11	116.9	16.4	4.6	13	121.7	5.5	1.6	12
33	TVVSP2-VVIT STATIC-WRONG	.01	4.9	5.1	1.4	13	4.2	3.4	1.0	12
34	TVVSP3-VVIT STATIC-OMIT	.14	7.2	14.4	4.0	13	3.2	4.5	1.3	12
35	TVVDP1-VVIT DYNAMIC-RIGHT	1.19	70.0	21.6	6.0	13	53.4	36.4	10.5	12
36	TVVDP2-VVIT DYNAMIC-WRONG	3.49	10.0	4.6	1.3	13	6.1	5.9	1.7	12
37	TVVDP3-VVIT DYNAMIC-OMIT	1.06	40.2	22.7	6.3	13	69.5	38.6	11.1	12
38	TVVIR-VVIT RATER	3.94	16.2	3.9	1.1	13	23.0	11.3	3.3	12
39	TVVIS-VVIT SELF-RATING	5.25	13.0	4.4	1.2	13	21.0	8.6	2.5	12
40	TVVIP-VVIT POST-RATING	12.99•	2.2	2.7	.7	13	30.7	30.7	8.9	12
41	TVVIT-VVIT TIME OF DAY	.43	10.7	2.8	.6	13	10.1	1.2	.3	12

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
D = SIGNIFICANT BEYOND THE .01 LEVEL
• = SIGNIFICANT BEYOND THE .001 LEVEL
UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

Table XI

Results of a Kruskal-Wallis one-way analysis of variance comparison of students identified by the flight instructors as never being airsick with students identified by the instructors as having a relatively high incidence of airsickness (see Table VII for an equivalent comparison based upon student judgments). The non-airsick group, defined as those students with a weighted airsickness index (variable 16 from the instructor questionnaire data) equal to 0.0, represented approximately 43 percent of the total study population. The airsick group was defined as those students with a weighted airsickness index equal to or greater than 16.5 which marked the upper decile for this measure.

NO.	RESPONSE VARIABLE DESCRIPTION	H STATISTIC	NON-AIRSICK MEAN	NON-AIRSICK S.DEV.	NON-AIRSICK S.ERR.	NON-AIRSICK N	AIRSICK MEAN	AIRSICK S.DEV.	AIRSICK S.ERR.	AIRSICK N
1	S-AIRSICKNESS INDEX-UW	90.39**	6.2	11.1	.9	160	44.7	16.0	2.5	41
2	S-VOMITING INDEX-UW	101.25**	.2	1.0	.1	160	32.0	12.0	1.9	41
3	S-P.DEGRADATION INDEX-UW	117.40**	3.7	11.6	.9	160	35.1	15.9	2.5	41
4	S-NERVOUSNESS INDEX-UW	24.98**	31.9	31.0	2.4	160	60.2	30.1	4.7	41
5	S-MEDICATION INDEX-UW	65.11**	.1	.9	.1	160	18.0	31.0	4.8	41
6	S-AIRSICKNESS INDEX-W	103.75**	2.6	6.8	.5	160	27.1	9.9	1.5	41
7	S-VOMITING INDEX-W	101.13**	.1	1.0	.1	160	19.2	8.5	1.3	41
8	S-P.DEGRADATION INDEX-W	122.92**	1.5	5.0	.4	160	19.0	10.0	1.7	41
9	S-NERVOUSNESS INDEX-W	24.47**	13.9	15.5	1.2	160	26.1	14.6	2.3	41
10	S-MEDICATION INDEX-W	65.11**	.1	.9	.1	160	10.0	31.0	4.8	41
11	I-AIRSICKNESS INDEX-UW	208.01**	.0	.0	.0	169	41.1	12.2	1.9	41
12	I-VOMITING INDEX-UW	199.79**	.0	.0	.0	169	32.7	11.6	1.8	41
13	I-P.DEGRADATION INDEX-UW	178.79**	.7	3.4	.3	169	32.8	12.5	2.0	41
14	I-NERVOUSNESS INDEX-UW	36.71**	15.3	16.2	1.2	169	37.5	21.1	3.3	41
15	I-TURBULENCE INDEX-UW	31.29**	16.1	15.0	1.2	169	34.2	18.5	2.9	41
16	I-AIRSICKNESS INDEX-W	208.04**	.0	.0	.0	169	23.5	7.4	1.2	41
17	I-VOMITING INDEX-W	199.76**	.0	.0	.0	169	18.0	8.4	1.3	41
18	I-P.DEGRADATION INDEX-W	172.05**	.3	1.2	.1	169	16.7	8.0	1.2	41
19	I-NERVOUSNESS INDEX-W	33.61**	6.2	7.2	.6	169	14.6	8.6	1.3	41
20	I-TURBULENCE INDEX-W	24.67**	8.2	8.3	.6	169	16.0	9.4	1.5	41
23	THS01-MS HISTORY, PART 1	32.09**	5.0	8.5	.7	159	15.4	13.7	2.2	39
24	THS02-MS HISTORY, PART 2	37.04**	3.2	5.6	.4	159	11.6	12.4	2.0	39
25	THS03-MS HISTORY, SUM	39.69**	8.2	12.3	1.0	159	27.0	23.6	3.8	39
26	TSANX-STATE/ANX.QUEST.	9.48*	28.0	9.0	1.4	39	38.4	10.3	2.9	13
27	TTANX-TRAIT/ANX QUEST.	.89	28.6	6.1	1.0	39	28.9	4.8	1.4	12
28	TBVDT-BVDT TIME OF DAY	2.79	10.2	1.5	.1	157	9.8	2.0	.3	38
29	TBVDR-BVDT RATER	23.67**	12.1	4.9	.4	159	10.1	8.0	1.3	39
30	TBVDS-BVDT SELF-RATING	31.54**	12.0	5.8	.5	159	19.3	6.9	1.1	39
31	TBVDP-BVDT POST-RATING	17.38**	2.8	7.3	.6	147	15.0	26.5	4.4	37
32	TVVSP1-VVIT STATIC-RIGHT	7.47*	118.2	10.4	1.6	43	124.5	3.7	.9	10
33	TVVSP2-VVIT STATIC-WRONG	6.62	6.7	5.6	.9	43	3.1	3.6	.8	10
34	TVVSP3-VVIT STATIC-OMIT	3.04	4.1	6.5	1.3	43	1.0	2.1	.5	10
35	TVVDP1-VVIT DYNAMIC-RIGHT	1.14	66.1	25.5	3.9	43	56.4	33.3	7.6	10
36	TVVDP2-VVIT DYNAMIC-WRONG	2.46	10.4	7.4	1.1	43	7.7	7.3	1.7	10
37	TVVDP3-VVIT DYNAMIC-OMIT	1.62	52.5	26.6	4.1	43	64.0	34.7	8.7	10
38	TVVIR-VVIT RATER	8.00*	15.0	5.8	.9	43	23.4	11.0	2.6	10
39	TVVIS-VVIT SELF-RATING	12.64**	14.9	6.2	1.0	43	22.2	6.7	1.6	10
40	TVVIP-VVIT POST-RATING	12.34**	5.9	20.5	3.1	43	16.9	10.2	4.3	10
41	TVVIT-VVIT TIME OF DAY	.06	10.7	2.0	.3	43	16.9	2.1	.5	10

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX
* = SIGNIFICANT BEYOND THE .01 LEVEL
** = SIGNIFICANT BEYOND THE .001 LEVEL

mean index scores for the high-reactor were all greater without exception than the low-reactor group. Again, the three motion sickness history scores, the state/anxiety test, and the three BVDT rating tests show significant differences in the two populations. In addition, the three VVIT rating tests now statistically distinguish between populations. With even this cursory examination, it would appear that certain of the laboratory scores will be independent of student bias or approach in completing the flight questionnaires. In addition, it may be possible to utilize instructor-based measures of airsickness to establish validation criteria for future evaluation of selected laboratory test combinations.

FLIGHT AND LABORATORY DATA CORRELATIONS

To gain some insight into the relationships that may exist among the response variables at this phase of the study, the data were exposed to a Spearman rank correlation analysis corrected for tied observations. The analysis included the total Squadron VT-10 population with the unweighted and weighted response indices calculated on the basis of the total number of hops flown by a given student. The results of this rank correlation analysis are presented in matrix form in Table XII; the total number of data pairs associated with a given correlation coefficient within this matrix is tabulated in similar form in Table XIII. Table XII also lists the unity value correlation of a variable with itself so as to establish the total number of observations available for analysis. As before, correlations between the academic and flight grades (variables 21 and 22) are not included in this table because of the different grade references used by the MAFB students who flew only the first five familiarization hops of the Squadron VT-10 flight syllabus. To establish the statistical significance of the rank correlation coefficients, a t statistic was calculated for each relationship and a standard two-tailed Student t-test table evaluation made. Those correlations which the t-test evaluation identified as being statistically significant at the .01 and .001 levels or greater are identified accordingly in Table XII.

A cursory examination of the Table XII rank correlation coefficients for the twenty questionnaire-derived response indices shows a considerable number of significant intercorrelations, as would be expected. For example, the unweighted and weighted indices for the student-based data are all correlated to the .9 level or greater. The same applies for the instructor-based indices. Considering the three response variables that are, by definition, directly related to motion sickness, i.e., airsickness, vomiting, and performance degradation due to airsickness, it can be observed in Table XII that the corresponding student and instructor ratings are correlated to the .7 level or greater. This holds for both the unweighted and weighted indices. The highest correlation between the student and instructor responses for these three variables is .93 for the vomit index which, due to the overt nature of this symptom, is not at all surprising. A further observation concerns the severity of the airsickness experienced as measured by the weighted airsickness indices assigned by the student (variable 6) and the instructor (variable 16). These airsickness indices were correlated with the weighted vomit index (severity measured by the number of times vomiting occurred) to the .73 level for the student data and to the .81 level for the instructor data. In effect, the judgment of airsickness severity was highly correlated with the number of times vomiting occurred. There was also a high correlation between the severity of performance degradation caused by airsickness and the severity of the airsickness and vomit experience.

The correlations between the nervousness indices and any of the three motion sickness-related indices, though statistically significant in most cases, were marked by considerably lower correlation coefficients. For the weighted indices, the largest correlation for the student nervousness index was .53, and this occurred relative to the related instructor judgment of nervousness. The same trend of statistically significant, but lower, correlation coefficients was observed for the medication usage index. The correlation coefficient between this variable and any of the three weighted motion sickness measures was in the .33 to .38 range for both the student and instructor data. The instructor-furnished turbulence or roughness-of-air data also displayed low correlation coefficients in relation to the same three motion sickness related indices. The turbulence index had correlation coefficients of .28, .33, and .28 relative to the weighted airsickness, vomiting, and performance degradation indices, respectively, based upon the student data, and coefficients of .31, .33, and .37, respectively, for the same indices derived from the instructor data.

The Table XII correlation matrix also permits a preliminary evaluation of the relationships that exist at this phase of the longitudinal study between the inflight airsickness measures (variables 1 through 20) and the individual laboratory tests (variables 23 through 41) undergoing evaluation. Laboratory tests that show statistically significant correlations with all three weighted airsickness, vomiting, and performance degradation indices derived from both the student and instructor data include the motion sickness case history (variables 23, 24, and 25), the BVDT rater score (variable 29), the BVDT self-rating score (variable 30), and the BVDT post-test self-rating score (variable 31). The VVIT self-rating score (variable 39) shows significant correlations with all three of the student-based weighted indices and two of the three instructor-based weighted indices. In the case of the VVIT rater score (variable 38), statistically significant correlations exist between the student-based vomit index and the instructor-based airsickness index. State/anxiety scores (variable 26) also showed statistically significant correlations with all three of the student-based airsickness indices and two of the corresponding instructor-based indices. None of the other test scores showed any statistically significant relationship with any of the indices, weighted or unweighted.

The correlation matrix also provides a cursory look at the intra-correlations that exist among certain of the laboratory tests. For example, the BVDT rater score is significantly correlated with the related self-rating and post-test self-rating BVDT scores, as well as the VVIT rater, self-rating, and post-test self-rating scores, the three motion sickness case history scores, and the state/anxiety questionnaire score. A small negative correlation exists between this score and the dynamic performance VVIT score. It should be observed that for the majority of the laboratory tests, a high score or rating denotes either greater susceptibility to disorientation or motion sickness, or poorer performance on an assigned task. The exceptions to this rule include the first score listed for the VVIT static performance test (variable 32) and the first score listed for the VVIT dynamic

Correlation matrix for the Squadron VT10 flight and

NO.	RESPONSE VARIABLE DESCRIPTION	1	2	3	4	5	6	7	8	9	10	11	12
1	S-AIRSICKNESS INDEX-UW	1.00											
2	S-VOMITING INDEX-UW	.60•	1.00										
3	S-P.DEGRADATION INDEX-UW	.77•	.66•	1.00									
4	S-NERVOUSNESS INDEX-UW	.43•	.24•	.42•	1.00								
5	S-MEDICATION INDEX-UW	.31•	.36•	.34•	.15o	1.00							
6	S-AIRSICKNESS INDEX-W	.97•	.73•	.80•	.43•	.33•	1.00						
7	S-VOMITING INDEX-W	.60•	.99•	.67•	.24•	.30•	.73•	1.00					
8	S-P.DEGRADATION INDEX-W	.78•	.69•	.98•	.42•	.36•	.82•	.70•	1.00				
9	S-NERVOUSNESS INDEX-W	.42•	.25•	.42•	.98•	.15o	.43•	.25•	.42•	1.00			
10	S-MEDICATION INDEX-W	.31•	.36•	.34•	.15o	1.00	.33•	.30•	.36•	.15o	1.00		
11	I-AIRSICKNESS INDEX-UW	.80•	.77•	.72•	.32•	.36•	.83•	.76•	.73•	.32•	.36•	1.00	
12	I-VOMITING INDEX-UW	.67•	.93•	.66•	.24•	.36•	.72•	.93•	.69•	.25•	.36•	.79•	1.0
13	I-P.DEGRADATION INDEX-UW	.68•	.70•	.71•	.20•	.36•	.71•	.71•	.74•	.29•	.36•	.70•	.7
14	I-NERVOUSNESS INDEX-UW	.37•	.26•	.30•	.53•	.15o	.39•	.26•	.30•	.55•	.15o	.30•	.2
15	I-TURBULENCE INDEX-UW	.29•	.30•	.30•	.24•	.17•	.30•	.37•	.31•	.24•	.17•	.34•	.3
16	I-AIRSICKNESS INDEX-W	.80•	.79•	.73•	.32•	.30•	.84•	.79•	.76•	.32•	.30•	.99•	.8
17	I-VOMITING INDEX-W	.67•	.92•	.66•	.24•	.37•	.72•	.93•	.69•	.25•	.37•	.78•	.9
18	I-P.DEGRADATION INDEX-W	.68•	.71•	.72•	.20•	.36•	.72•	.72•	.75•	.29•	.36•	.78•	.7
19	I-NERVOUSNESS INDEX-W	.34•	.25•	.36•	.52•	.13o	.36•	.24•	.36•	.53•	.13o	.39•	.2
20	I-TURBULENCE INDEX-W	.27•	.34•	.26•	.17•	.15o	.20•	.33•	.20•	.17•	.15o	.30•	.3
23	TMSQ1-MS HISTORY,PART 1	.44•	.37•	.30•	.10•	.10•	.43•	.30•	.30•	.17•	.10•	.40•	.3
24	TMSQ2-MS HISTORY,PART 2	.44•	.42•	.35•	.16o	.22•	.44•	.42•	.36•	.15o	.22•	.40•	.3
25	TMSQ3-MS HISTORY,SUM	.40•	.44•	.41•	.20•	.23•	.40•	.44•	.41•	.19•	.23•	.44•	.4
26	TSANX-STATE/ANX.QUEST.	.30•	.33•	.30•	.17	.10	.40•	.34•	.34•	.10	.10	.34•	.2
27	TTANX-TRAIT/ANX.QUEST.	.24	.04	.10	.13	-.00	.21	.05	.17	.14	-.00	.15	.0
28	TDVDT-DVDT TIME OF DAY	-.11	-.11	-.04	-.03	-.11	-.12	-.12	-.04	-.02	-.11	-.12	-.1
29	TDVDR-DVDT RATER	.36•	.36•	.33•	.15o	.14o	.36•	.36•	.33•	.16o	.14o	.33•	.3
30	TDVDS-DVDT SELF-RATING	.42•	.30•	.40•	.16o	.17o	.45•	.39•	.41•	.18•	.17o	.37•	.3
31	TDVDP-DVDT POST-RATING	.29•	.29•	.31•	.13	.12	.30•	.29•	.30•	.15o	.12	.28•	.2
32	TVVSP1-VVIT STATIC-RIGHT	.05	.14	.12	.06	.02	.12	.15	.12	.09	.02	.23	.1
33	TVVSP2-VVIT STATIC-WRONG	-.03	-.13	-.07	-.04	-.01	-.11	-.13	-.07	-.08	-.01	-.20	-.1
34	TVVSP3-VVIT STATIC-OMIT	-.03	-.11	-.14	-.07	.00	-.00	-.12	-.12	-.07	.00	-.15	-.1
35	TVVDP1-VVIT DYNAMIC-RIGHT	-.05	-.12	-.07	-.02	-.05	-.03	-.12	-.03	-.06	-.05	-.08	-.1
36	TVVDP2-VVIT DYNAMIC-WRONG	-.08	-.14	-.14	-.07	.01	-.11	-.14	-.14	-.11	.01	-.13	-.1
37	TVVDP3-VVIT DYNAMIC-OMIT	.07	.13	.09	.10	.04	.08	.12	.08	.08	.04	.10	.1
38	TVVIR-VVIT RATER	.30•	.30•	.26o	.10	.13	.27o	.33•	.21	.09	.13	.35•	.3
39	TVVIS-VVIT SELF-RATING	.31•	.37•	.34•	.23	.05	.33•	.38•	.32•	.23	.05	.36•	.3
40	TVVIP-VVIT POST-RATING	.23	.28o	.27o	.21	.11	.23	.26o	.22	.23	.11	.29o	.2
41	TVVIT-VVIT TIME OF DAY	.02	.07	.08	-.09	.02	.02	.07	.06	-.09	.02	-.03	.0

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
o = SIGNIFICANT BEYOND THE .01 LEVEL
• = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

Table XII

and laboratory data based upon the Spearman rank correlation coefficient adjusted for tied ranks.

RESPONSE VARIABLE

12	13	14	15	16	17	18	19	20	23	24	25	26	27	28	29	30	31	32	33
1.00																			
.78*	1.00																		
.28*	.37*	1.00																	
.39*	.41*	.36*	1.00																
.81*	.81*	.37*	.35*	1.00															
.99*	.79*	.27*	.36*	.81*	1.00														
.76*	.99*	.36*	.40*	.82*	.77*	1.00													
.27*	.37*	.90*	.35*	.39*	.27*	.36*	1.00												
.34*	.40*	.29*	.92*	.31*	.33*	.37*	.29*	1.00											
.35*	.36*	.08	.09	.42*	.36*	.37*	.06	.08	1.00										
.39*	.33*	.09	.09	.42*	.39*	.34*	.09	.08	.58*	1.00									
.41*	.30*	.09	.09	.46*	.41*	.40*	.09	.09	.91*	.84*	1.00								
.29*	.32*	.16	.07	.36*	.30*	.32*	.15	.03	.26*	.27*	.29*	1.00							
.05	.11	.14	-.00	.13	.07	.18	.10	-.07	.23	.13	.19	.40*	1.00						
.11	-.06	.03	-.02	-.12	-.11	-.06	.05	-.02	-.07	-.15*	-.12	-.02	-.03	1.00					
.31*	.30*	.14*	.07	.34*	.31*	.30*	.12	.04	.20*	.18*	.21*	.60*	.20	-.05	1.00				
.30*	.33*	.15*	.15*	.30*	.30*	.34*	.14*	.12	.33*	.20*	.36*	.66*	.30*	-.02	.53*	1.00			
.24*	.21*	.05	.00	.26*	.20*	.21*	.08	-.01	.31*	.28*	.35*	.61*	.27	-.04	.46*	.59*	1.00		
.17	.19	.04	.11	.24	.16	.20	.04	.14	.09	-.14	-.00	.12	-.08	.12	.14	.20	.21	1.00	
.15	-.14	-.04	-.07	-.21	-.14	-.18	-.05	-.13	-.05	.13	.01	-.09	.07	-.06	-.10	-.13	-.19	-.90*	1.00
.15	-.18	.01	-.11	-.14	-.15	-.17	.03	-.11	-.07	.13	.01	-.12	.04	-.14	-.12	-.16	-.07	-.70*	.30*
.11	-.12	.02	-.10	-.07	-.10	-.11	.02	-.07	-.12	-.15	-.13	-.20*	-.16	-.10	-.37*	-.17	-.29*	.19	-.19
.15	-.13	-.00	.10	-.15	-.15	-.14	-.11	.00	-.14	-.15	-.14	-.14	-.11	-.01	-.19	-.17	-.13	-.25*	.32*
.12	.14	-.00	.09	.09	.11	.13	.01	.06	.13	.15	.14	.23*	.10	.10	.30*	.19	.27*	-.12	.11
.20*	.27*	.08	.19	.34*	.27*	.28*	.07	.16	.35*	.43*	.41*	.23	.07	.02	.42*	.16	.31*	-.06	.01
.30*	.37*	.13	.20	.36*	.29*	.30*	.11	.19	.32*	.47*	.43*	.40*	.25	.03	.41*	.44*	.44*	.12	-.11
.23	.17	.09	.08	.30*	.22	.17	.08	.04	.25*	.31*	.32*	.30*	.13	-.04	.33*	.34*	.46*	-.02	.01
.04	.07	-.08	.03	-.00	.06	.07	-.07	.03	-.03	.07	.02	.03	.00	.30*	.06	.06	.09	.14	-.03

34	35	36	37	38	39	40	41
1.00							
-.13	1.00						
.08	.17	1.00					
.11*	-.30*	-.33	1.00				
.00	-.43*	-.20*	.46	1.00			
-.00	-.32*	-.33*	.03	.62*	1.00		
.02	-.27*	-.16	.04	.61*	.64*	1.00	
-.12	.01*	.23	-.06	.03	.06	.01	1.00

2

Matrix indicating the nu

RESPONSE VARIABLE NO.	DESCRIPTION	1	2	3	4	5	6	7	8	9	10
1	S-AIRSICKNESS INDEX-UW	391									
2	S-VOMITING INDEX-UW	391	391								
3	S-P.DEGRADATION INDEX-UW	391	391	391							
4	S-NERVOUSNESS INDEX-UW	391	391	391	391						
5	S-MEDICATION INDEX-UW	391	391	391	391	391					
6	S-AIRSICKNESS INDEX-W	391	391	391	391	391	391				
7	S-VOMITING INDEX-W	391	391	391	391	391	391	391			
8	S-P.DEGRADATION INDEX-W	391	391	391	391	391	391	391	391		
9	S-NERVOUSNESS INDEX-W	391	391	391	391	391	391	391	391	391	
10	S-MEDICATION INDEX-W	391	391	391	391	391	391	391	391	391	391
11	I-AIRSICKNESS INDEX-UW	389	389	389	389	389	389	389	389	389	389
12	I-VOMITING INDEX-UW	389	389	389	389	389	389	389	389	389	389
13	I-P.DEGRADATION INDEX-UW	389	389	389	389	389	389	389	389	389	389
14	I-NERVOUSNESS INDEX-UW	389	389	389	389	389	389	389	389	389	389
15	I-TURBULENCE INDEX-UW	389	389	389	389	389	389	389	389	389	389
16	I-AIRSICKNESS INDEX-W	389	389	389	389	389	389	389	389	389	389
17	I-VOMITING INDEX-W	389	389	389	389	389	389	389	389	389	389
18	I-P.DEGRADATION INDEX-W	389	389	389	389	389	389	389	389	389	389
19	I-NERVOUSNESS INDEX-W	389	389	389	389	389	389	389	389	389	389
20	I-TURBULENCE INDEX-W	389	389	389	389	389	389	389	389	389	389
23	TMSQ1-MS HISTORY,PART 1	362	362	362	362	362	362	362	362	362	362
24	TMSQ2-MS HISTORY,PART 2	362	362	362	362	362	362	362	362	362	362
25	TMSQ3-MS HISTORY,SUM	362	362	362	362	362	362	362	362	362	362
26	TSANX-STATE/ANX.QUEST.	103	103	103	103	103	103	103	103	103	103
27	TTANX-TRAIT/ANX.QUEST.	102	102	102	102	102	102	102	102	102	102
28	TSVDT-SVDT TIME OF DAY	350	350	350	350	350	350	350	350	350	350
29	TSVDR-SVDT RATER	363	363	363	363	363	363	363	363	363	363
30	TSVDS-SVDT SELF-RATING	363	363	363	363	363	363	363	363	363	363
31	TSVDP-SVDT POST-RATING	340	340	340	340	340	340	340	340	340	340
32	TVVSP1-VVIT STATIC-RIGHT	119	119	119	119	119	119	119	119	119	119
33	TVVSP2-VVIT STATIC-WRONG	119	119	119	119	119	119	119	119	119	119
34	TVVSP3-VVIT STATIC-OMIT	119	119	119	119	119	119	119	119	119	119
35	TVVDP1-VVIT DYNAMIC-RIGHT	119	119	119	119	119	119	119	119	119	119
36	TVVDP2-VVIT DYNAMIC-WRONG	119	119	119	119	119	119	119	119	119	119
37	TVVDP3-VVIT DYNAMIC-OMIT	119	119	119	119	119	119	119	119	119	119
38	TVVIR-VVIT RATER	119	119	119	119	119	119	119	119	119	119
39	TVVIS-VVIT SELF-RATING	119	119	119	119	119	119	119	119	119	119
40	TVVIP-VVIT POST-RATING	119	119	119	119	119	119	119	119	119	119
41	TVVIT-VVIT TIME OF DAY	119	119	119	119	119	119	119	119	119	119

S = STUDENT RESPONSE DATA
I = INSTRUCTOR RESPONSE DATA
* = SIGNIFICANT BEYOND THE .01 LEVEL
** = SIGNIFICANT BEYOND THE .001 LEVEL

UW = UNWEIGHTED RESPONSE INDEX
W = WEIGHTED RESPONSE INDEX

Table XIII

mber of data-pairs used in the calculation of the Table XII Spearman rank correlation coefficients

	RESPONSE VARIABLE																		
11	12	13	14	15	16	17	18	19	20	23	24	25	26	27	28	29	30	31	
391																			
391	391																		
391	391	391																	
391	391	391	391																
391	391	391	391	391															
391	391	391	391	391	391														
391	391	391	391	391	391	391													
391	391	391	391	391	391	391	391												
391	391	391	391	391	391	391	391	391											
391	391	391	391	391	391	391	391	391	391										
362	362	362	362	362	362	362	362	362	362	378									
362	362	362	362	362	362	362	362	362	362	378	378								
362	362	362	362	362	362	362	362	362	362	378	378	378							
103	103	103	103	103	103	103	103	103	103	105	105	105	105						
102	102	102	102	102	102	102	102	102	102	104	104	104	104	104					
350	350	350	350	350	350	350	350	350	350	369	369	369	105	104	378				
363	363	363	363	363	363	363	363	363	363	374	374	374	105	104	370	378			
363	363	363	363	363	363	363	363	363	363	373	373	373	105	104	369	374	374		
340	340	340	340	340	340	340	340	340	340	351	351	351	94	93	347	352	351	382	
119	119	119	119	119	119	119	119	119	119	120	120	120	105	104	119	119	119	105	1
119	119	119	119	119	119	119	119	119	119	120	120	120	105	104	119	119	119	105	1
119	119	119	119	119	119	119	119	119	119	120	120	120	105	104	119	119	119	105	1
119	119	119	119	119	119	119	119	119	119	120	120	120	105	104	119	119	119	105	1
119	119	119	119	119	119	119	119	119	119	120	120	120	105	104	119	119	119	105	1
119	119	119	119	119	119	119	119	119	119	120	120	120	105	104	119	119	119	105	1
119	119	119	119	119	119	119	119	119	119	120	120	120	105	104	119	119	119	105	1
119	119	119	119	119	119	119	119	119	119	120	120	120	105	104	119	119	119	105	1
119	119	119	119	119	119	119	119	119	119	119	119	119	105	104	119	119	119	105	1
119	119	119	119	119	119	119	119	119	119	120	120	120	105	104	119	119	119	105	1

Table XIII

Data-pairs used in the calculation of the Table XII Spearman rank correlation coefficients

RESPONSE VARIABLE

12	13	14	15	16	17	18	19	20	23	24	25	26	27	28	29	30	31	
)1																		
)1	391																	
)1	391	391																
)1	391	391	391															
)1	391	391	391	391														
)1	391	391	391	391	391													
)1	391	391	391	391	391	391												
)1	391	391	391	391	391	391	391											
1	391	391	391	391	391	391	391	391										
2	362	362	362	362	362	362	362	362	378									
2	362	362	362	362	362	362	362	362	378	378								
2	362	362	362	362	362	362	362	362	378	378	378							
3	103	103	103	103	103	103	103	103	108	108	108	108						
2	102	102	102	102	102	102	102	102	104	104	104	104	104					
3	380	380	380	380	380	380	380	380	369	369	369	108	104	378				
3	363	363	363	363	363	363	363	363	374	374	374	108	104	370	378			
3	363	363	363	363	363	363	363	363	373	373	373	108	104	369	374	374		
3	348	348	348	348	348	348	348	348	351	351	351	94	93	347	382	351	382	
)	119	119	119	119	119	119	119	119	120	120	120	108	104	119	119	119	108	1
)	119	119	119	119	119	119	119	119	120	120	120	108	104	119	119	119	108	1
)	119	119	119	119	119	119	119	119	120	120	120	108	104	119	119	119	108	1
)	119	119	119	119	119	119	119	119	120	120	120	108	104	119	119	119	108	1
)	119	119	119	119	119	119	119	119	120	120	120	108	104	119	119	119	108	1
)	119	119	119	119	119	119	119	119	120	120	120	108	104	119	119	119	108	1
)	119	119	119	119	119	119	119	119	120	120	120	108	104	119	119	119	108	1
	119	119	119	119	119	119	119	119	120	120	120	108	104	119	119	119	108	1
	119	119	119	119	119	119	119	119	119	119	119	108	104	119	119	119	108	1
	119	119	119	119	119	119	119	119	120	120	120	108	104	119	119	119	108	1

2	33	34	35	36	37	38	39	40	41
22									
22	122								
22	122	122							
22	122	122	122						
22	122	122	122	122					
22	122	122	122	122	122				
22	122	122	122	122	122	122			
22	122	122	122	122	122	122	122		
21	121	121	121	121	121	121	121	121	
22	122	122	122	122	122	122	122	121	122

performance test (variable 35). In these cases, as explained in Appendix B, a high score denotes good performance (the number of correct responses). This negative correlation would then suggest that poor performance (a high score) on the BVDT rotor test would be accompanied by poor performance (a low score) on the VVIT dynamic performance test.

Another test intra-correlation of interest involves the time of day that the BVDT and VVIT were given to the students (variables 28 and 41, respectively). These data were entered into the analysis to investigate any potential diurnal effects on the magnitude of the responses evoked by these two tests. During the conduct of these tests students were exposed to the related stimuli at times ranging from early in the morning until late in the afternoon. In general, most of the tests were given during the morning hours. The question of interest involved the potential change in vestibular sensitivity as a function of the time of day. The Table XII data indicate that there were no significant correlations between the time that the BVDT was given and any of the three related BVDT response scores. The same applies for the time that the VVIT was given. In effect, statistical evidence to show diurnal effects on either of these tests was not present over the denoted time period.

In conclusion, it is emphasized that final decisions on the merit evaluation of the different laboratory tests included in the study must await completion of the longitudinal study of this population. Future reports will deal with the progress of this specific student population through advanced training into the fleet readiness squadrons. In addition, as a result of a change in the flight syllabus for Squadron VT-10, a second group of students will be followed through the same pipeline, providing further insight into the NFO airsickness problem during basic training.

REFERENCES

1. Anon., Science and Technology Objective Personnel/Medical (STO-PN), Section 11, Personal/Medical Operational Problems, 10 July 1977.

2. Bruner, J. M., Seasickness in a destroyer escort squadron. U. S. Armed Forces Med. J., 6:469-490, 1955.

3. Claytor, W. G., POM-80 Department of the Navy Planning and Programming Guidance (DNPPG) Memorandum. Washington, DC: Department of the Navy, Office of the Secretary, 29 November 1977.

4. Dobie, T. G., Airsickness in aircrew. AGARD AG-177. London: Technical Editing and Reproduction, Ltd., 1974.

5. Hemingway, A., and Green, E. L., Airsickness during early flying training. J. Aviat. Med., 16:409-416, 1945.

6. Ireland, R. G., and Nelson, P. D., Navy Decision Coordinating Paper, Fleet Health Standards, NDCP #M0096-PN, Program Element 63706. Bethesda, MD: Naval Medical Research and Development Command, 22 February 1977.

7. Money, K. E., Motion sickness. Physiol. Rev., 50:1-39, 1970.

8. Reason, J. T., Motion sickness - some theoretical considerations. Int. J. Man-Mach. Stud., 1:21-38, 1969.

9. Ryback, R. S., Rudd, R. E., Matz, G. J., and Jennings, C. L., Motion sickness in USAF flying personnel. Aerospace Med., 41:672-677, 1970.

10. Siegel, S., Nonparametric Statistics for the Behavioral Sciences. New York: McGraw-Hill, 1956.

11. Tucker, G. J., Hand, D. J., Godbey, A. L., and Reinhardt, R. F., Airsickness in student aviators. Aerospace Med., 36:1200-1202, 1965.

APPENDIX A

Brief Description of Individual Hops Comprising the Pre-1978 Basic Training Squadron VT-10 Flight Syllabus

Hop Code	Hop Description
FM1	Initial familiarization hop demonstrating aircraft p rformance. General indoctrination involving Yankee departure, stall series, unusual attitudes (mild), climbs, turns, angle of attack, and gyro operation.
FM2 FM3 FM4	Familiarization hops involving high-altitude navigation. Primarily straight and level flight with no acrobatics.
FM5	Familiarization hop demonstrating aircraft performance and acrobatics. Maneuvers include stalls, minimum radius turns, SAM break, aileron roll, wing-over, barrel-roll, loop, one-half Cuban eight, Immelman, and split S.
IN1 IN2 IN3 IN4 IN5 IN6	High-level instrument navigation training generally involving straight and level flight. Instrument hood mandatory for IN5 with IN6 serving as check flight.
VN1 VN2 VN3 VN4	Low-altitude, high-speed visual navigation training generally involving straight and level flight with possibility of buffeting according to atmospheric conditions. Hop VN4 served as check flight.
FO1	Basic section formation training involving parade turns, cross-under, break-up and rendezvous, free cruise, lead change, tactical wing, combat spread, in-place turn, hard turn, called turn, uncalled turn.
FO2 FO3	Basic section formation and basic fighter maneuver training involving gunsight tracking, abeam attack, defense against high yo-yo attack, low yo-yo attack, displacement roll, and no flap touch and go.

The principal aircraft used during training was the T-2. A secondary aircraft, the T-39D, was used on some hops but never for hops involving acrobatics or formation flight. The average duration of each hop was approximately 1.3 hours.

APPENDIX B

Brief Description of Laboratory Tests Comprising the 1977-1978 Prototype Motion Sickness Sensitivity Test Battery

Variable No.	Symbol Code	Test Description
23 24 25	TMSQ1 TMSQ2 TMSQ3	Two-part motion sickness history form describing motion sickness incidence and exposure level. TMSQ1 summarizes the history before the age of 12 and has a minimum value of 0.0 denoting no problems and a maximum value of 180 denoting high susceptibility. TMSQ2 pertains to motion sickness experience following age 12 with the same minimum and maximum values. TMSQ3 is the numerical sum of the TMSQ1 and TMSQ2 scores. For details, see Reason, J. T., An investigation of some factors contributing to individual variation in motion sickness susceptibility. FPRC Committee Report 1277. London: Ministry of Defence, 1968.
26 27	TSANX TTANX	This State-Trait Anxiety Inventory is comprised of two self-report scales. The State Anxiety scale (TSANX) requires the individual to report how he feels at that particular moment in time, while the Trait Anxiety scale (TTANX) requires the individual to report how he generally feels. Both scales have a minimum score of 20, denoting minimum anxiety and a maximum score of 80 denoting maximum anxiety. For details, see Spielberger, C. D., Gorsuch, R. L., and Lushene, R. E., STAI Manual for the State-Trait Anxiety Inventory. Palo Alto, CA: Consulting Psychologists Press, 1970.
28 29 30 31	TBVDT TBVDR TBVDS TBVDP	Brief Vestibular Disorientation Test (BVDT) involving cross-coupled angular acceleration stimuli produced by paced head motions on a rotating chair. TBVDT denotes the time of day the test was given based on a 24-hour decimal clock. TBVDR is the test score given by the rating panel and has a minimum value of 6 denoting no motion symptoms and a maximum value of 60 denoting a maximal motion sickness reaction. Immediately following the BVDT, each subject rated his own reactions to the test coded as TBVDS with a minimum score of 7 indicating no reaction and a maximum score of 49 denoting high reaction. A report of aftereffects was obtained from the subject 24 hours later and coded as TBVDP with a minimum score of 0 denoting no aftereffects and a maximum score of 180 denoting a high level of after effects. For details, see Lentz, J. M., Holtzman, G. L., Hixson, W. C., and Guedry, F. E., Normative data for two short tests of motion reactivity. NAMRL-1243. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1977.

Variable No.	Symbol Code	Test Description
32 33 34	TVVSP1 TVVSP2 TVVSP3	These scores pertain to the task performance element of the Visual-Vestibular Interaction Test (VVIT). The tasks involve the visual scan, acquisition and identification of a complex numerical display. Under static conditions, TVVSP1 denotes the number of correct responses, TVVSP2 the number of incorrect responses, and TVVSP3 the number of omitted responses.
35 36 37	TVVDP1 TVVDP2 TVVDP3	The dynamic performance test scores TVVDP1, TVVDP2, and TVVDP3 describe the same response scores recorded while the subject undergoes passive sinusoidal rotation. For both the static and dynamic performance tests, the minimum and maximum scores within a given response category are 0 and 129, respectively, with the further condition that sum of the correct, incorrect, and omitted scores must total 129. For details, see Lentz, J. M., Holtzman, G. L., Hixson, W. C., and Guedry, F. E., Normative data for two short tests of motion reactivity. NAMRL-1243. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1977.
38 39 40 41	TVVIR TVVIS TVVIP TVVIT	These scores pertain to the motion sickness symptom rating element of the Visual-Vestibular Interaction Test (VVIT). TVVIR is the test score given by the rating panel and has a minimum value of 6 denoting no motion sickness symptoms and a maximum value of 60 denoting a maximal motion sickness reaction. Immediately following the VVIT, each subject rated his own reaction to the test, which was coded as TVVIS, with a minimum score of 7 denoting no reaction and a maximum score of 70 denoting high reaction. A report of aftereffects was obtained from the subject approximately 24 hours later and coded as TVVIP with a minimum score of 0 denoting no aftereffects and maximum score of 180 denoting a high level of aftereffects. TVVIT denotes the time of day the test was administered based upon a 24-hour decimal clock. For details, see Lentz, J. M., Holtzman, G. L., Hixson, W. C., and Guedry, F. E., Normative data for two short tests of motion reactivity. NAMRL-1243. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 1977.

APPENDIX C

Normalized Cumulative Frequency Distribution of Flight Indices and Laboratory Test Scores for the Squadron VT-10 Population (Pre-1978 Flight Syllabus)

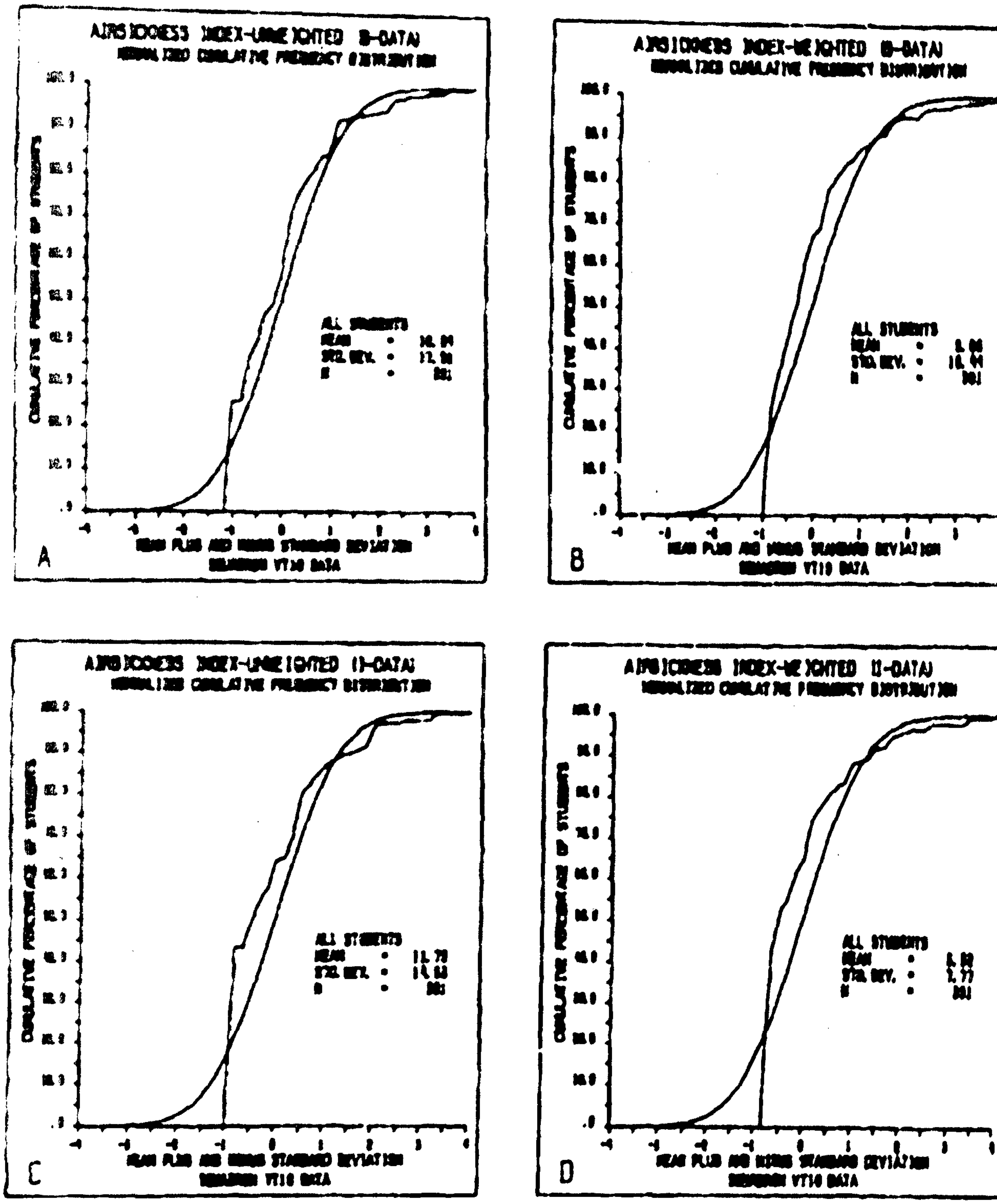


Figure C1

Normalized cumulative frequency distributions of unweighted (A) and weighted (B) airsickness indices calculated from the student questionnaire data and the equivalent unweighted (C) and weighted (D) indices calculated from the instructor data. Each plot contains the distribution of the observed data (irregular curve) and an equivalent Gaussian distribution (smooth curve) with the same mean and standard deviation as the observed data. The weighted data are later used to define susceptible (upper decile) and nonsusceptible (indices = 0.0) student populations.

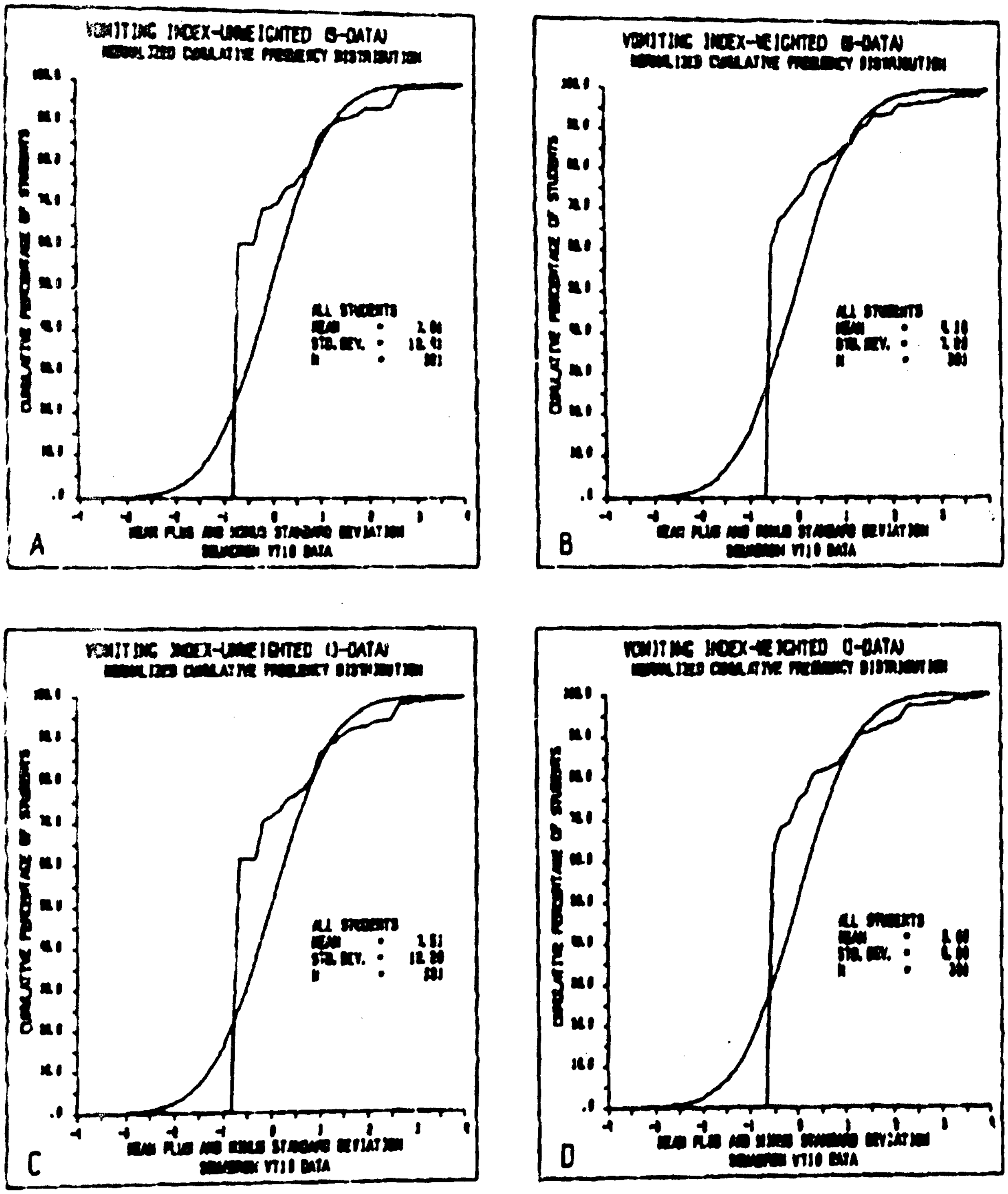


Figure C2

Normalized cumulative frequency distributions of unweighted and weighted vomit indices following the Figure C1 format. The weighted student data (B) indicate that approximately 61 percent of the students never vomited during flight training. The 90-percent point of the same plot was used to define the most sensitive (upper decile) group of students with weighted vomit indices equal to or greater than 14.4 (see Table VIII analysis).

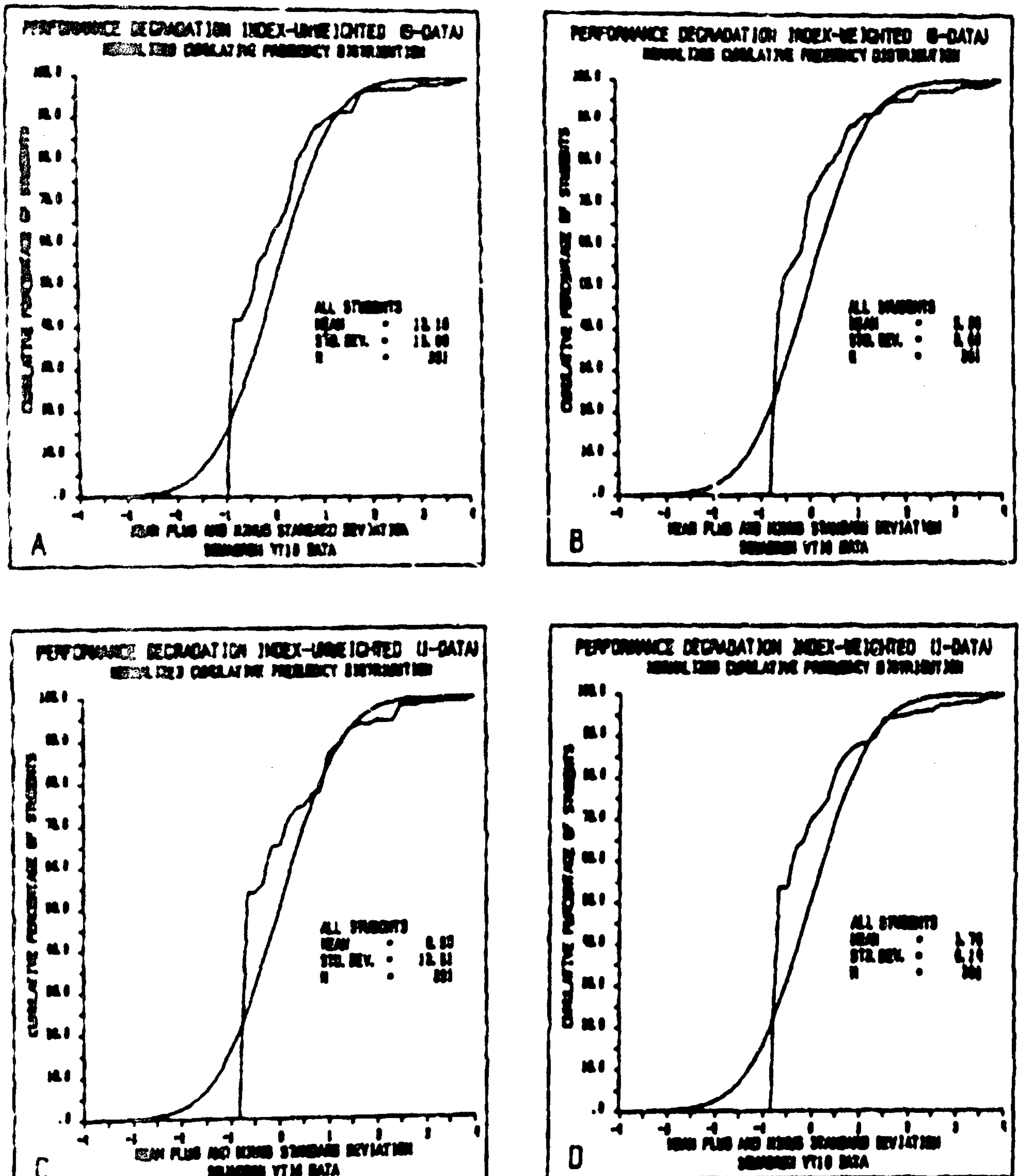


Figure C3

Normalized cumulative frequency distributions of unweighted and weighted performance degradation indices following the Figure C1 format. The weighted student data (B) indicate that approximately 42 percent of the students reported never experiencing performance degradation due to airsickness. A weighted index of approximately 16.0 defined the upper decile score for the most sensitive students (see Table IX analysis).

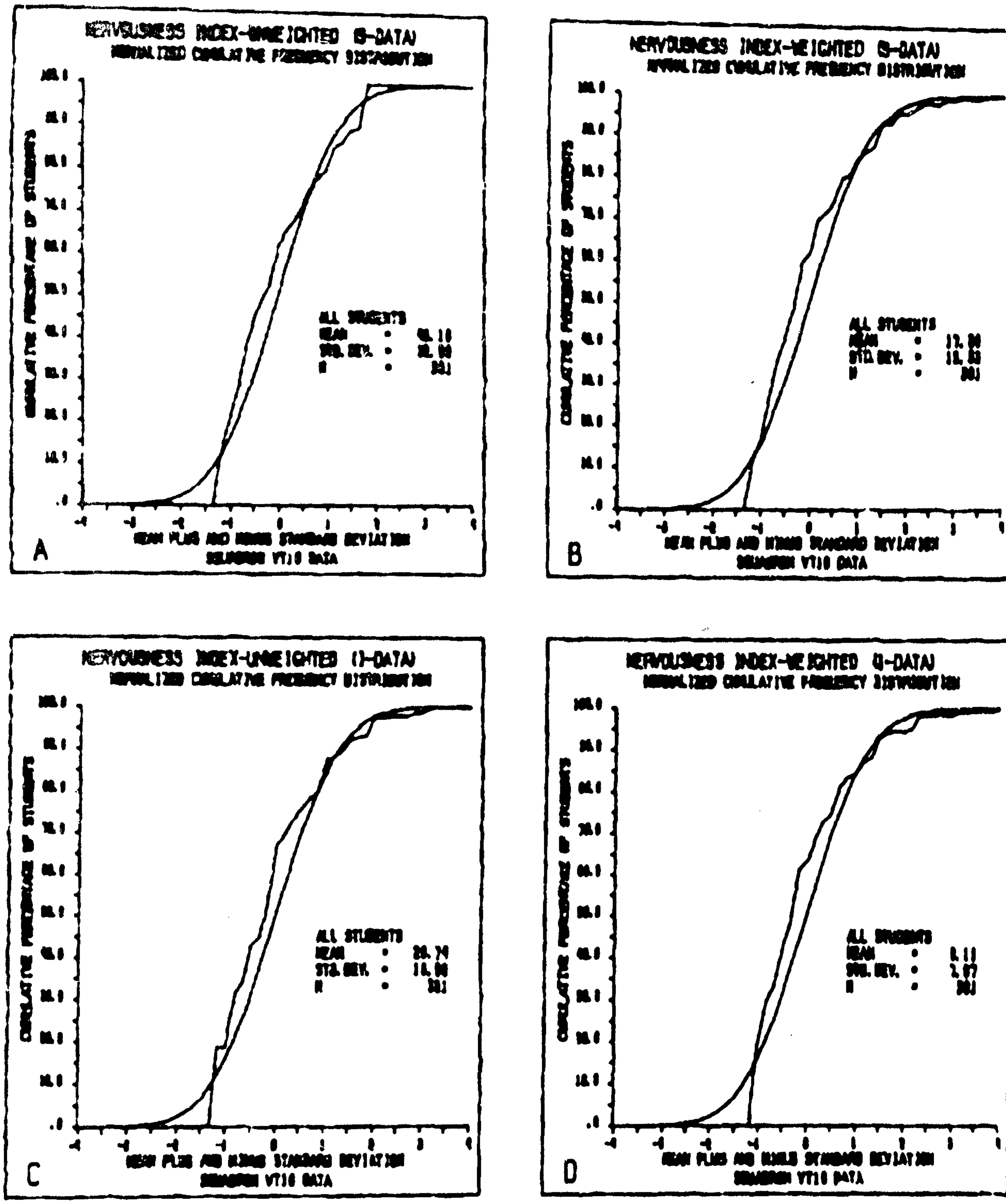


Figure C4

Normalized cumulative frequency distributions of unweighted and weighted nervousness indices following the Figure C1 format. The weighted student data (B) indicate that only 11 percent of the students reported that they were never nervous either before or during any flight during training. A weighted index of approximately 40.5 defined the upper decile score for the most nervous students (see Table X analysis).

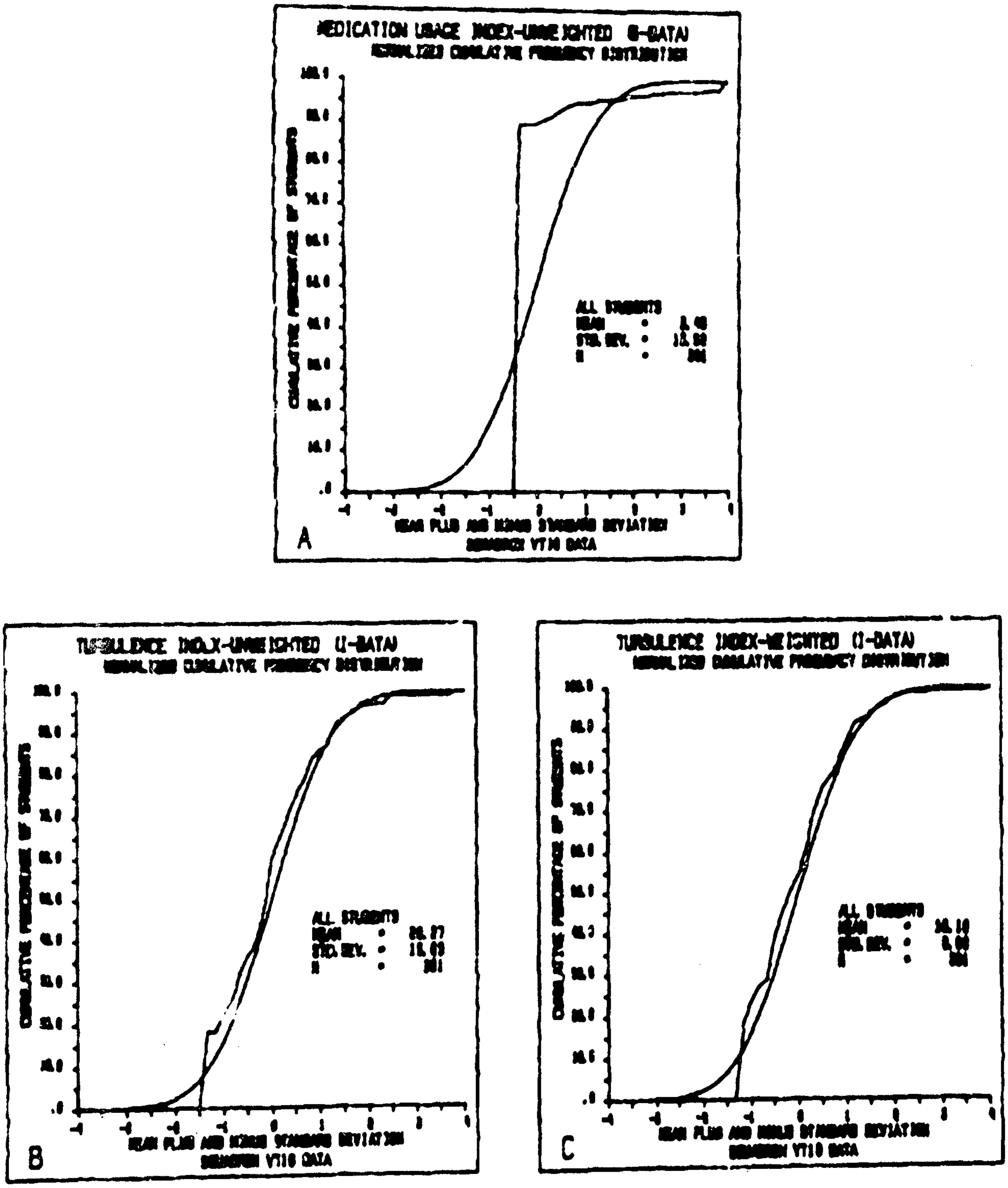


Figure C5

Normalized cumulative frequency distributions of the student-derived medication usage index (A) and the instructor-derived unweighted (B) and weighted (C) turbulence indices. The medication data again emphasize the relatively small number of students reporting the use of airsickness drugs during training. The turbulence data, as compared to the other indices, more closely approach a normal distribution.

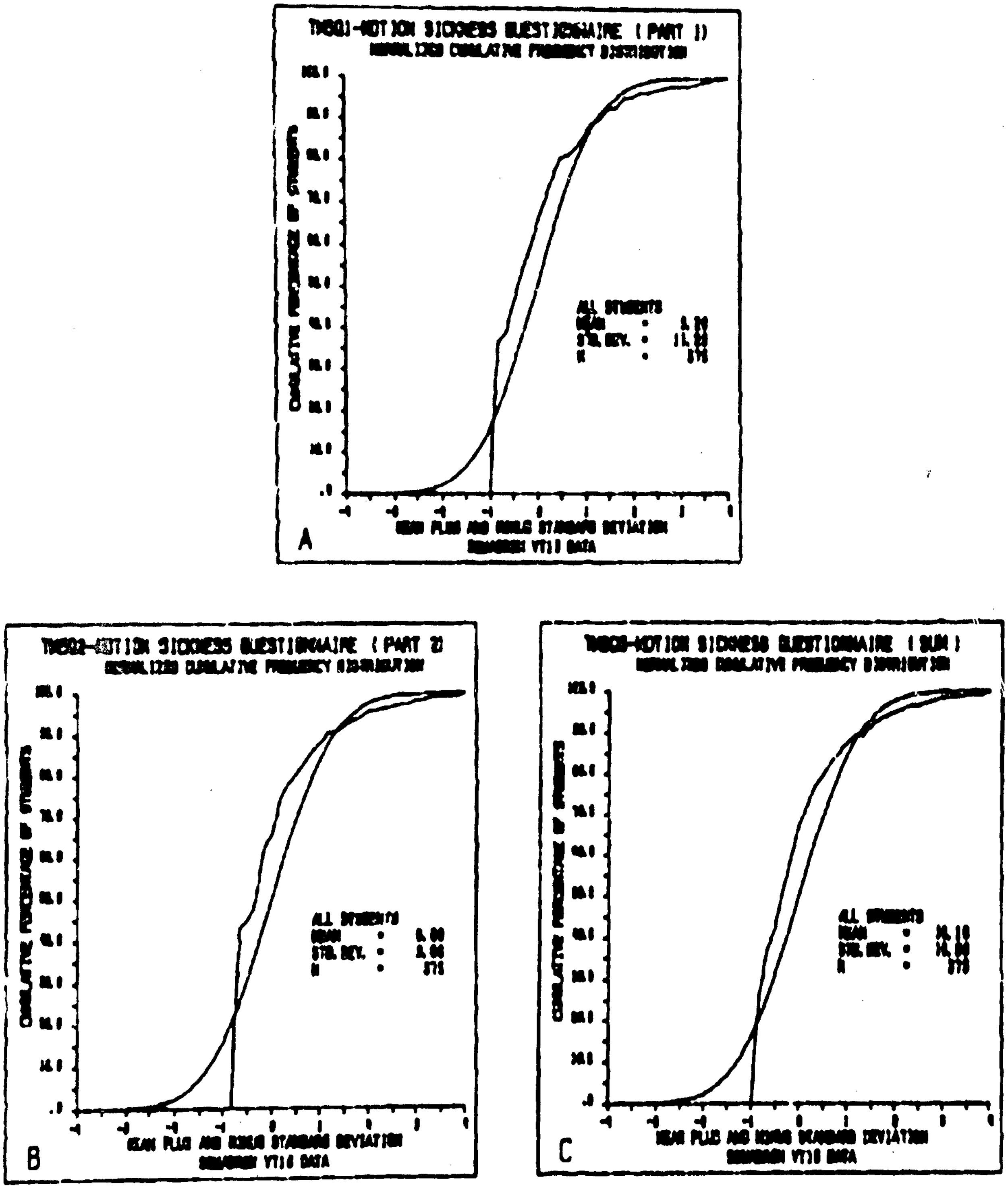
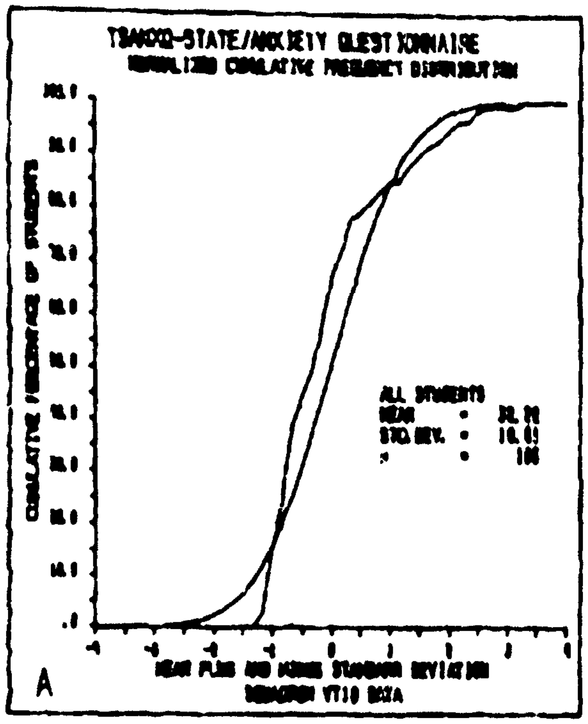


Figure C6

Normalized cumulative frequency distributions (irregular curve) of the three motion sickness history scores derived from the VT-10 population. Each plot also shows the equivalent distribution of a theoretical Gaussian population (smooth curve) with the same mean and standard deviation as the related laboratory test scores.



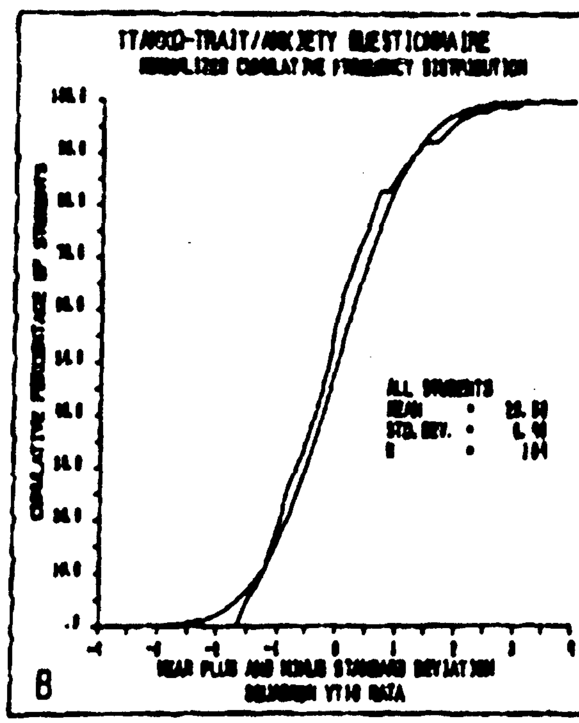


Figure C7

Normalized cumulative frequency distributions of state/anxiety (A) and trait/anxiety (B) test scores based upon the observed data (irregular curves) and a theoretical Gaussian population (smooth curves) having the same mean and standard deviation as the observed test scores.

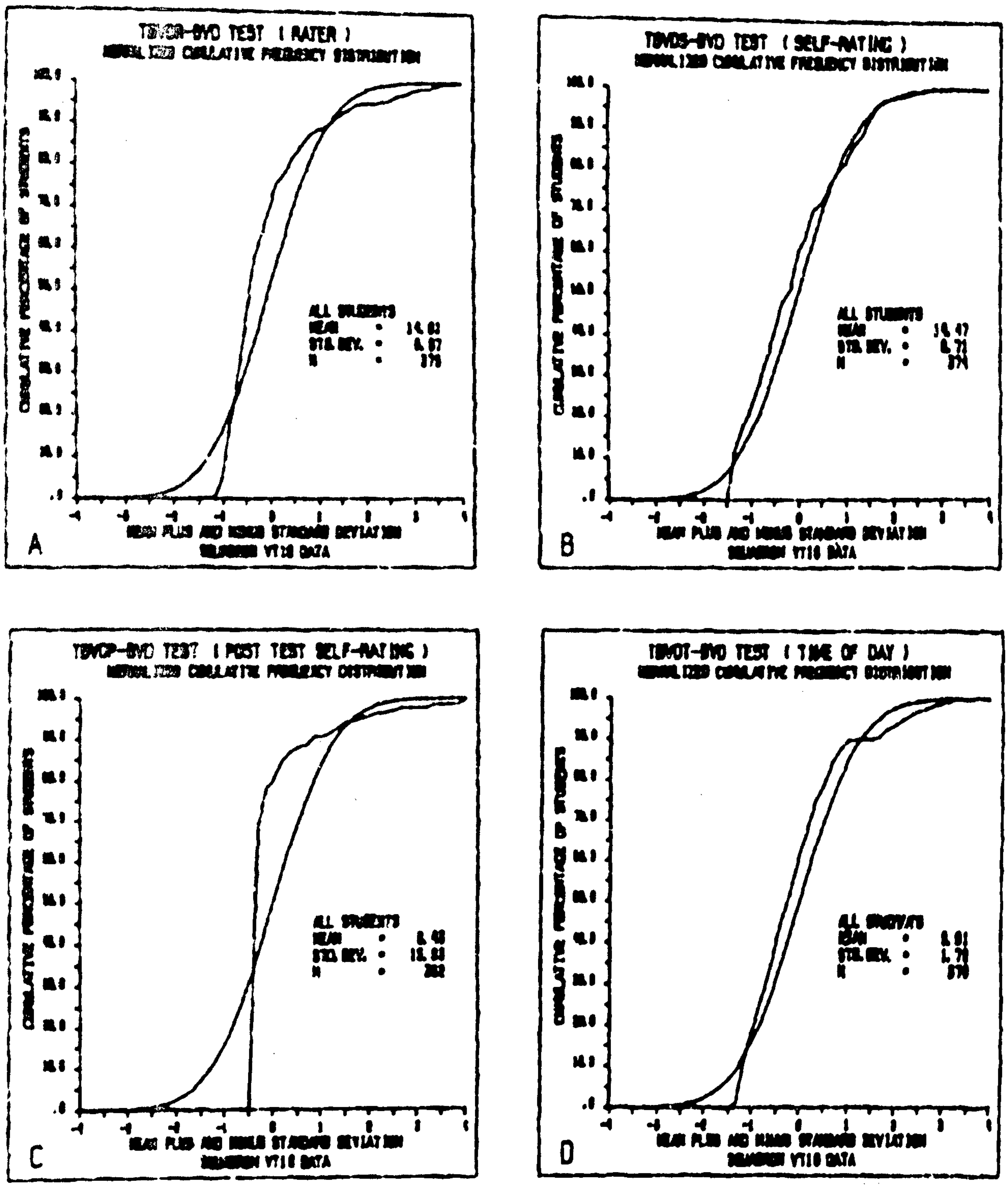


Figure C8

Normalized cumulative frequency distributions of the Brief Vestibular Disorientation Test (BVDT) scores (irregular curves) and equivalent theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations.

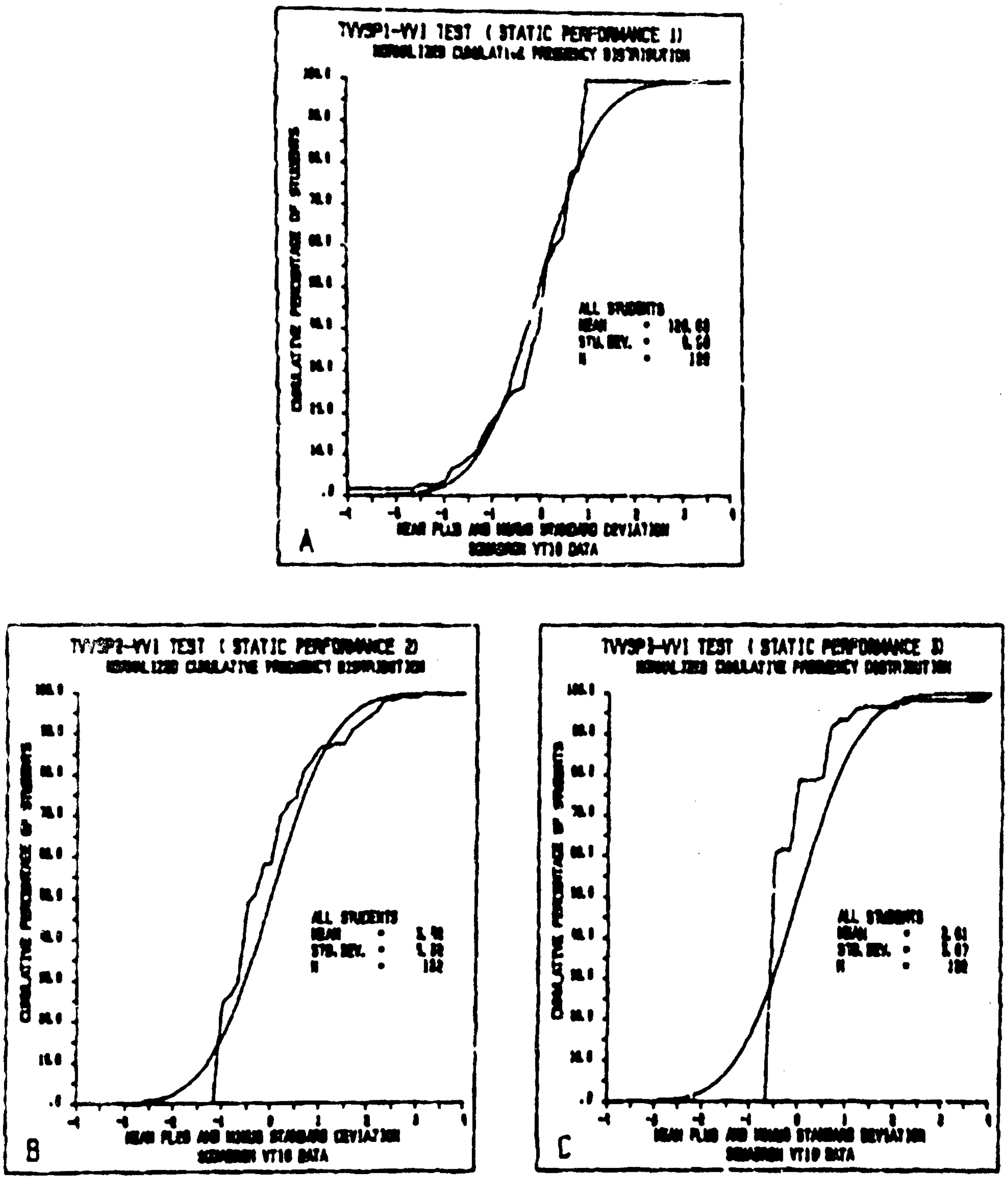


Figure C9

Normalized cumulative frequency distributions of three static performance test scores (irregular curves) associated with the Visual-Vestibular Interaction Test (VVIT) and the related theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations as those of the test scores.

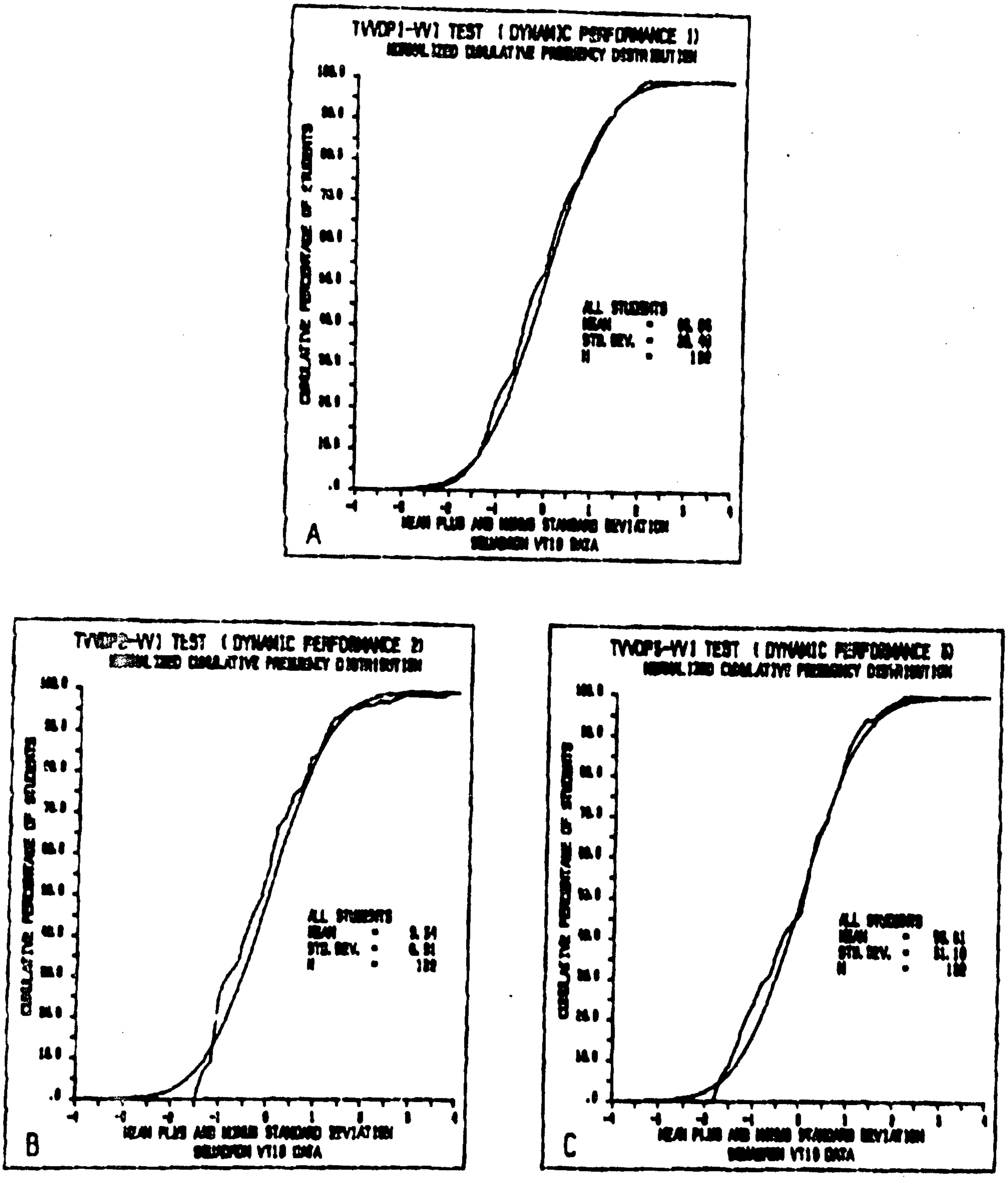


Figure C10

Normalized cumulative frequency distributions of the three dynamic performance test scores (irregular curves) associated with the Visual-Vestibular Interaction Test (VVIT) and the related theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations as those of the test scores.

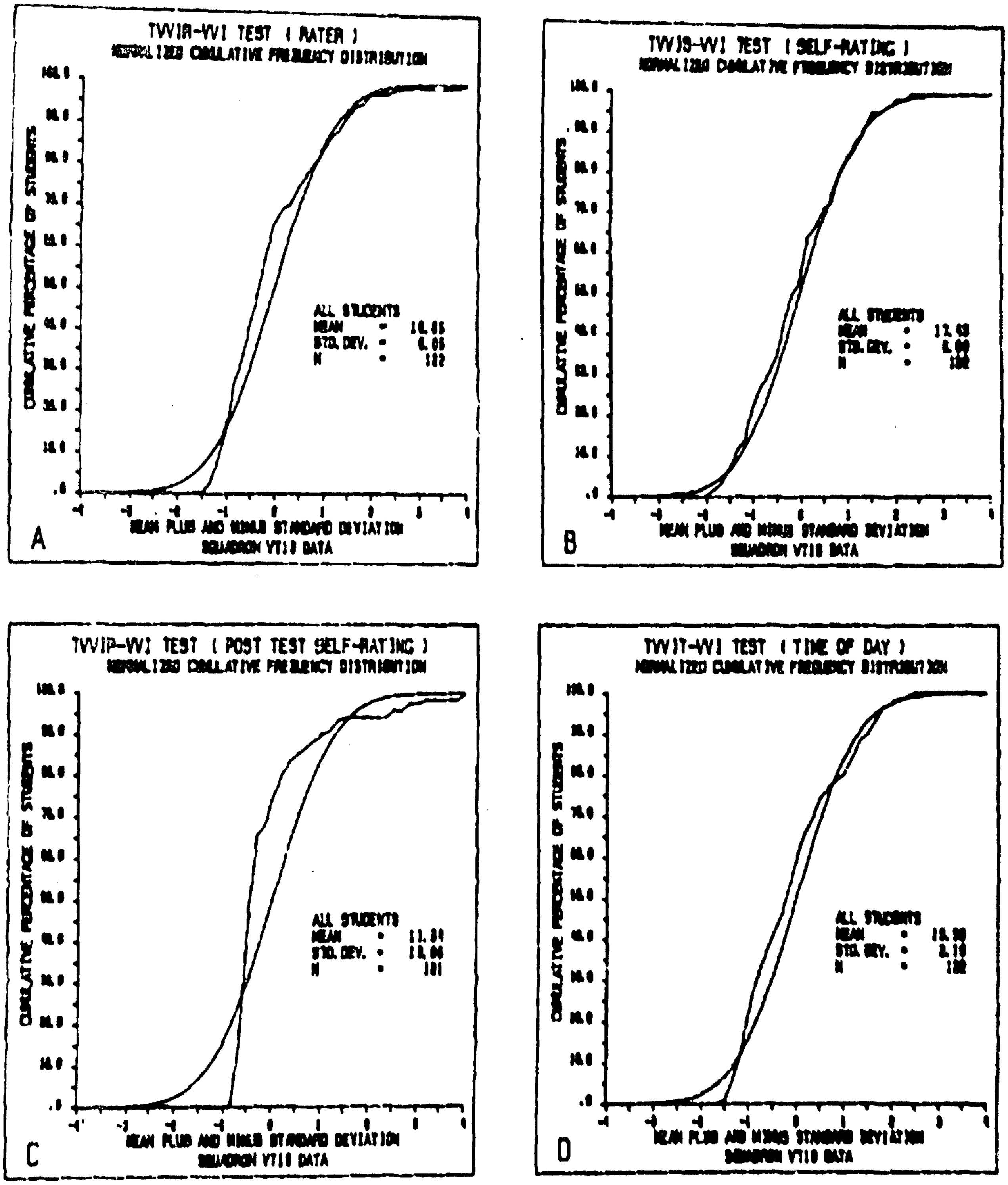


Figure C11

Normalized cumulative frequency distributions of the four rating-based Visual-Vestibular Interaction Test (VVIT) scores (irregular curves) and the related theoretical distributions (smooth curves) of Gaussian populations with the same means and standard deviations as those of the test scores.

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NAMRL-1258	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Airsickness during Naval Flight Officer Training: Basic Squadron VT-10		5. TYPE OF REPORT & PERIOD COVERED Interim
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) W. Carroll Hixson, Fred E. Guedry, Jr., Garry L. Holtzman, CDR, MC, USN, J. Michael Lentz, and P. F. O'Connell, CAPT, MC, USN		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Aerospace Medical Research Laboratory and Naval Aerospace Medical Institute Naval Air Station, Pensacola, Florida 32508		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS ZF51.524.005-7032
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Medical Research and Development Command National Naval Medical Center Bethesda, Maryland 20014		12. REPORT DATE 8 April 1979
		13. NUMBER OF PAGES 66
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Mr. Hixson and Drs. Guedry and Lentz are with the Naval Aerospace Medical Research Laboratory; Commander Holtzman and Captain O'Connell are with the Naval Aerospace Medical Institute.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Naval aviation; Aviation medicine; Naval Flight Officers; Basic training; Aircrew performance; Attrition; Airsickness; Motion sickness; Biomedical tests

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report is the first in a series dealing with a longitudinal study of Naval Flight Officer airsickness in the Basic, Advanced, and Fleet Readiness (RAG) squadrons comprising the complete training program. Data from 5,394 hops flown by 408 VT-10 students indicate that airsickness occurred on approximately 16 percent of the total hops flown, vomiting occurred on 7 percent of the total, and performance degradation caused by airsickness occurred on 11 percent of the flights. Approximately 74 percent of the students reported being airsick on at least one flight, 39 percent reported vomiting on one or more flights,

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE S/N 0102-014-6601

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) and 59 percent considered their flight performance to have been degraded by airsickness on one or more hops. The report details the incidence of airsickness by hops and by students; presents the results of several brief motion reactivity tests to which a large segment of the population was exposed; and relates the flight and test data for different student subpopulations.

Hixson, W. C. 1979
F. E. Guedry, Jr., G. L. Holtzman, J. M. Lentz,
P. F. O'Connell

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: BASIC SQUADRON VT-10. NAMRL-1258. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 8 April.

This report is the first in a series dealing with a longitudinal study of Naval Flight Officer airsickness in the Basic, Advanced, and Fleet Readiness (RAG) squadrons comprising the complete training program. Data from 5,394 hops flown by 488 VT-10 students indicate that airsickness occurred on approximately 16 percent of the total hops flown, vomiting occurred on 7 percent of the total, and performance degradation caused by airsickness occurred on 11 percent of the flights. Approximately 74 percent of the students reported being airsick on at least one flight, 39 percent reported vomiting on one or more flights, and 59 percent considered their flight performance to have been degraded by airsickness on one or more hops. The report details the incidence of airsickness by hops and by students; presents the results of several brief motion sensitivity tests to which a large segment of the population was exposed; and relates the flight and test data for different student subpopulations.

Naval aviation
Aviation medicine
Naval Flight Officers
Basic training
Aircrew performance
Attrition
Airsickness
Motion sickness
Biomedical tests

Hixson, W. C. 1979
F. E. Guedry, Jr., G. L. Holtzman, J. M. Lentz,
P. F. O'Connell

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: BASIC SQUADRON VT-10. NAMRL-1258. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 8 April.

This report is the first in a series dealing with a longitudinal study of Naval Flight Officer airsickness in the Basic, Advanced, and Fleet Readiness (RAG) squadrons comprising the complete training program. Data from 5,394 hops flown by 488 VT-10 students indicate that airsickness occurred on approximately 16 percent of the total hops flown, vomiting occurred on 7 percent of the total, and performance degradation caused by airsickness occurred on 11 percent of the flights. Approximately 74 percent of the students reported being airsick on at least one flight, 39 percent reported vomiting on one or more flights, and 59 percent considered their flight performance to have been degraded by airsickness on one or more hops. The report details the incidence of airsickness by hops and by students; presents the results of several brief motion sensitivity tests to which a large segment of the population was exposed; and relates the flight and test data for different student subpopulations.

Naval aviation
Aviation medicine
Naval Flight Officers
Basic training
Aircrew performance
Attrition
Airsickness
Motion sickness
Biomedical tests

Hixson, W. C. 1979
F. E. Guedry, Jr., G. L. Holtzman, J. M. Lentz,
P. F. O'Connell

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: BASIC SQUADRON VT-10. NAMRL-1258. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 8 April.

This report is the first in a series dealing with a longitudinal study of Naval Flight Officer airsickness in the Basic, Advanced, and Fleet Readiness (RAG) squadrons comprising the complete training program. Data from 5,394 hops flown by 488 VT-10 students indicate that airsickness occurred on approximately 16 percent of the total hops flown, vomiting occurred on 7 percent of the total, and performance degradation caused by airsickness occurred on 11 percent of the flights. Approximately 74 percent of the students reported being airsick on at least one flight, 39 percent reported vomiting on one or more flights, and 59 percent considered their flight performance to have been degraded by airsickness on one or more hops. The report details the incidence of airsickness by hops and by students; presents the results of several brief motion sensitivity tests to which a large segment of the population was exposed; and relates the flight and test data for different student subpopulations.

Naval aviation
Aviation medicine
Naval Flight Officers
Basic training
Aircrew performance
Attrition
Airsickness
Motion sickness
Biomedical tests

Hixson, W. C. 1979
F. E. Guedry, Jr., G. L. Holtzman, J. M. Lentz,
P. F. O'Connell

AIRSICKNESS DURING NAVAL FLIGHT OFFICER TRAINING: BASIC SQUADRON VT-10. NAMRL-1258. Pensacola, FL: Naval Aerospace Medical Research Laboratory, 8 April.

This report is the first in a series dealing with a longitudinal study of Naval Flight Officer airsickness in the Basic, Advanced, and Fleet Readiness (RAG) squadrons comprising the complete training program. Data from 5,394 hops flown by 488 VT-10 students indicate that airsickness occurred on approximately 16 percent of the total hops flown, vomiting occurred on 7 percent of the total, and performance degradation caused by airsickness occurred on 11 percent of the flights. Approximately 74 percent of the students reported being airsick on at least one flight, 39 percent reported vomiting on one or more flights, and 59 percent considered their flight performance to have been degraded by airsickness on one or more hops. The report details the incidence of airsickness by hops and by students; presents the results of several brief motion sensitivity tests to which a large segment of the population was exposed; and relates the flight and test data for different student subpopulations.

Naval aviation
Aviation medicine
Naval Flight Officers
Basic training
Aircrew performance
Attrition
Airsickness
Motion sickness
Biomedical tests